FOOD AND FEEDING BEHAVIOUR OF 'NORTHERN ROSERINGED PARAKEET, *Psittacula Krameri borealis* (*Neuman*) AND IT'S IMPACT ON AGRICULTURAL CROPS AND ORCHARDS IN ALIGARH

DISSERTATION

SUBMITTED IN PARTIAL FULFILMENT FOR
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IN

Wildlife Science

BY

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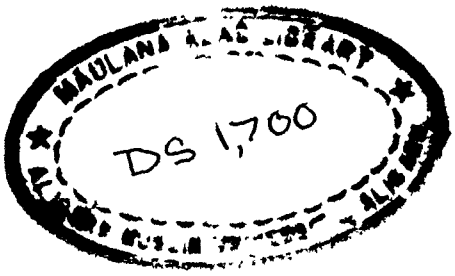

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CERTIFICATE

This is to certify that the dissertation on the "Food and feeding behaviour of roseringed parakeet (Psittacula krameri borealis) and its impact on agricultural crops and orchards in Aligarh" for the award of M.Phil degree, is the original work of Mr. Salim Javed. This work has been done under my supervision.

(H.S.A. Yahya)

CONTENTS

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INTRODUCTION

Out of the 13 species of parakeets occuring in the Indian subcontinent, the Northern Roseringed parakeet, Psittacula krameri borealis (Neuman) is most common bird with wide distributional range (Ali & Ripley 1969). The northern roseringed parakeet belongs to the order psittaciformes, family Psittacidae and genus Pstittacula. There are two sub-species of Psittacula krameri, the Northern Roseringed parakeet Psittacula krameri borealis and the rosergined parakeet Psittacula krameri manillensis. The two sub-species differ only in the colour of lower mandible. Psittacula krameri borealis which is distributed in the Aligarh region has its lower mandible red while Pstittacula krameri manillensis has black.

The northern Roseringed Parakeet Psittacula krameri borealis has a very wide distribution occuring from West Pakistan (Baluchistan, Sind, NWF districts, Punjab) and and the whole northern India, eastward along the Himalayan foothills, terai and entire gangetic plain through Assam and east Pakistan. Nepal tarai & bhabar.

It affects the moist deciduous biotope, even semi desert or keeping to light secondary jungle gardens, orchards, cultivation in the neighbourhood of human habitation. It was introduced in Andaman by Col. Tytler 100 years ago - but couldn't succeed. (Ali & Ripley 1969).

Species Description

The Northern Roseringed Parakeet Psittacula krameri borealis (Neuman), locally known as Tota (Hindi) is a slim grass green parakeet with an indistinct emerald green ring around the neck. The overall length of the bird is about 42 cm with long pointed tail. Sexual dimorphism exists, male with a rose - pink and black collar without any shoulder patch while female is without collar but with indistinct emerald green ring round the neck. Young ones are like females but the male get pink and black collar in the third year.

It is an arboreal fruit eating bird, bill short, stout, strongly hooked, upper mandible loosely articulated with the skull capable of kinetic movement. Tongue thick and fleshy, feet zygodoclytous, adapted for clambering among the branches and holding the food. These anatomical and morphological features help greatly in their feeding.

The parakeets have been labelled as pests of crops and orchards by the virtue of their feeding habits and rightly labelled as the most destructive avian pest species in the Indian condition. Various authors have taken up the work on the problem birds but the roseringed parakeet has been largely neglected except for some studies on the damage aspect by Ali et al (1971), Ramzan & Toor (1971 & 1972), Simwat and Sidhu (1974), Sandhu & Dhindsa (1982) Ali et al (1982), Shafi et al (1984), Malhi and Brar (1985 & 1988). But most of these work has been on the damage aspect of the feeding of roseringed parakeet. Inspite of previous studies this project on the food and feeding behaviour of parakeets and its impact on agricultural crops was taken up to know about the incidence and degree of damage to crops and orchards in the Aligarh region.

Though there have been few studies on the problem birds in India and there management, there is a paucity of detail and systematic information in this field and a great many biological problems await solution by intensive ecological research. One of the such problem is pertaining to the role of species in the natural ecosystems. Agriculture is a basic and traditional form of human activity in

it is associated with mankind since ages. Different biogeographical realms provide the existing pattern of agricultural crops, their combination and various problem associated with them. One of the several problems which has plagued the agricultural production in India, and elsewhere in the world, is of some avian pest species.

Damage to agricultural crops and orchards by birds has been mentioned frequently in literatures and their depredatory activities are known since the beginning of the agricultural practices. The use of various indigenous devices such as slingshots, drum beating, calling, and scarecrow, speaks volumes about this problem. The last few decades has been challenging as different part of the globe faced food shortages, mostly due to natural calamities viz. drought, flood etc. but aggravating this problem are some pest species. Red billed quelea Quelea quelea is one of the most numerous avian pest species in Africa. The magnitude of damage is so high that it's being speculated as one of the factors contributing to famine (Elliot 1982).

In India there are quite a few birds such as parakeets, finches, sparrows, crows, startlings, mynas, weaver birds and rosy pastors which do great damage to agricultural crops, orchards and stored grains. As India's economy is dependent on agriculture, it becomes imperative and important to study the problem birds and their management. After the pioneering work of Mason and Lefroy (1912) and De Abrew (1920), it was Salim Ali whose thought provoking work gave a new dimension to this problem. Ali (1936) emphasised the role of birds in agriculture and forestry and appealed to the scientist to work on this challenging problem. Since then quite a few workers have taken up this problem. Hussain & Bhalla (1931, 1937 a & b), Hartley (1948), Ali (1949, 1963, 1973, 1977), and Mukherjee (1966-1976). In 1963 the first status report on problem birds was published by the Government of India.

The intial work of these authors provided the much needed impetus, and the need for the creation of a section for "economic ornithology" was realised. The first of its kind was established in the Division of Entomology, US Department of Agriculture - India soon followed it up with the setting up of section of economic ornithology at Indian Agricultural Research Institute (New Delhi). It further progressed with the establishment of centres at

agricultural universities of Tamil Nadu, Andhra Pradesh and Punjab and of late these Universities had been the Centre of such activities. Ramzan & Toor (1972), Sidhu & Simwat (1973), Simwat (1973,1974 & 1975), Bhatnagar (1975,1976 a & b), Mehrotra & Bhatnagar (1976), Ali et al (1976), Mathews (1976) & Mathews et al (1980) have contributed notably to the field of economic ornithology.

Work on the problem birds has also been done in other countries, particularly the tropical countries, where it is more serious. In Africa the red-billed quelea is the most common bird pest of cereal crops. Bruggers (1989), Manikowski & Smeets (1984), Tobin et al (1988) have done work on the problems birds and their management. The Somali-German Bird Damage Prevention Project in Southern Somalia has yielded some valuable results. Besides this various other agencies and individual researchers are engaged in working out this problem. Of late the emphasis has shifted on the management aspect of the problem birds. Chemical such as Methiocarb,Fenhthion, Malathion, α-2-Chloralose, 4-aminophyridine, have been frequently experimented outside India. Methiocarb has been found to be affective repellent.Bhatnager (1988) used sprays of Methiocarb for feeding aversion. But the use of chemicals in Indian

conditions is not common as in other countries. Frequent use of chemicals and other toxic substances are not advisable. As chemicals will add to the pollution and it's better to explore other possibilities viz. bioacoustics, reflecting tape, stupefying substances,(Mehrotra and Bhatnagar 1977), or various other devices unless it becomes unavoidable. Various other methods can be worked out only after a through and systematic study on this aspect.

As the geographical and ecological condition varies from one region to another. The agricultural pattern also varies, with different crop combination, area under a particular crop cropping intesity and other factors which influences the crop regime and various problems related to it. Mathews (1982) stressed on detail study viz. the status, feeding habits breeding biology and population dynamics in different agricultural areas.

The present study on the Northern Roseringed parakeets was envisaged with the idea to study food and feeding behaviour of birds and to know the impact of feeding on agricultural crops and orchard i.e. damage assessment and if possible suggest a suitable control measure, coming out through the course of this project.

OBJECTIVES

The following are the objectives of this project:

(1) To obtain the information regarding crop pattern, fruiting and other phenological observation.

(2) Study of food and feeding behaviour of parakeets, feeding methods and interaction with other animals.

(3) Quantification of damage for crops and orchards.

ALIGARH DISTRICT : HISTORICAL BACKGROUND

The district of Aligarh is named after its headquarters town Aligarh, which itself receives this name from the fort of Aligarh, originally built in 1524 by Muhammad Khan, the Governor of Koil under Lodis. It was rebuilt in 1717 by Sabit Khan a Turkoman Governor and was later on known as Sabitgarh. In 1757 it was taken by the Jats and named Ramgarh. Present appellation of Aligarh was given by Afrasyab Khan in 1782.

LOCATION & BOUNDARIES

The district of Aligarh comprises the northern most portion of Agra division and lies in the upper Ganga - Yamuna doab. It extends from 27^{o} 29 N lat to 28^{o} 11 'N latitude and 77^{o} 29 'E long. to 78^{o} 38 'E longitude. To the north the boundary touches Bulandshahar, on the South West lies the district of Mathura. On the West it is separated from

Haryana by Yamuna. The greatest length of the district is about 120 Km from Yamuna to Ganga near northern border and the maximum breadth from North to South is some 72 Km. (Fig. 1 & 2).

AREA

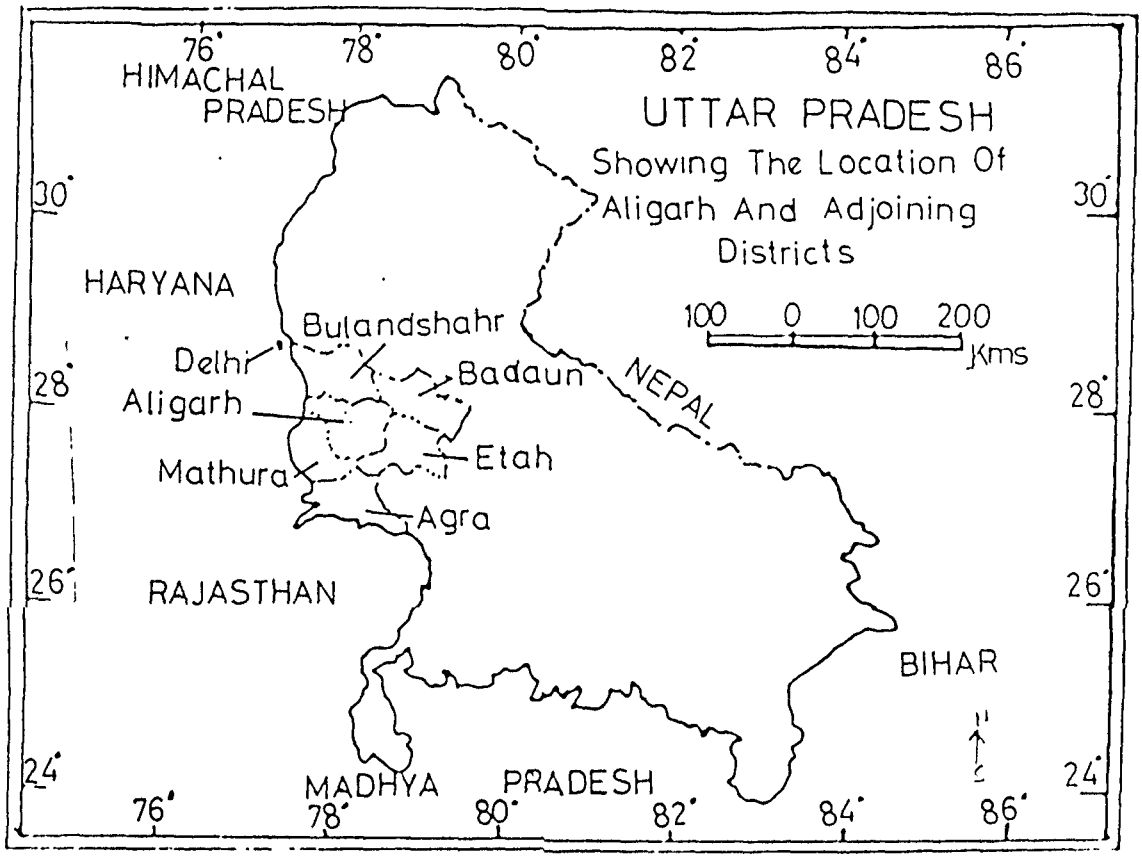
According to Central Statistical Organisation the district covered an area of about 5024 sq Km in 1971 and stood 27th in the State in respect of area. According to Board of Revnue the area in the same year was 5030 sq. Km.

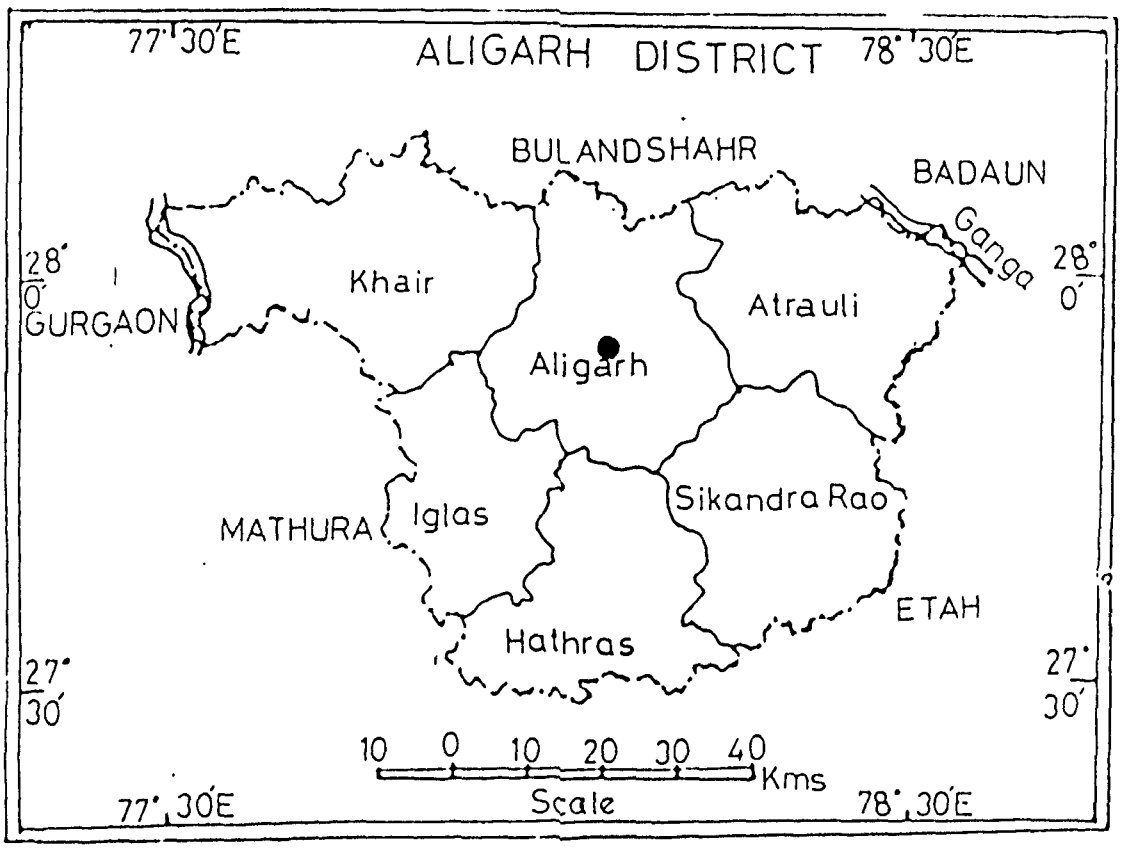
TOPOGRAPHY

The district lying in the featurless upper Ganga plain is an area of remarkable fertility. It slopes gently from north to south-east. The surface is varied by several depressions formed by the river valleys and natural drainage lines. The configuration of the ground is very similar to that of the doab. The general level of the district is extremely regular. The greatest height being 195 meters above sea level at Chandaus.

GEOLOGY

The geology of the district is stample and rather monotonuous, comprising only the Gangetic alluvium. The main





Figs. 1 & 2 : Showing the location of Aligarh and it's adjoining districts.

constituents of allivium are clays silts, sands and Kankar. Alluvium is few hundred meters in thickness. Gangetic alluvium is devoid of minerals. The only minerals found in the district are kankar, reh and clay.

WATER RESOURCES

The district is not traversed by any major river, the Ganga, merely touches it in north-east, while the Yamuna flows along its western boundary for a short distance. The other streams running through the district are the Kali, the Isan, the tributaries of Ganga, the Nuir - tributary of Kali and Rind, the Senger, the Karawan and the Patwaha-tributaries of Yamuna.

CLIMATE

The climate of the district is tropical monsoon type. It is characterised by a hot summer, pleasant winter and general dryness except the monsoon season. The early March is followed by the hot season, lasting till middle of June. The south-west monsoon season is from the middle of June to about third week of September.

(a) TEMPERATURE

Day & night temperature decreases rapidly from about middle of November. January is the coldest month with mean daily maximum temperature of 21.7° C and the mean daily minimum temperature at 7.6° C. The average daily temperature maximum and minimum are given in Table (1), Fig (3). Cold waves in the wake of western disturbances cause the further lowering of temperature and the mercury drops down to freezing point & thus some times frost also occur. After February temperature increases and May is the hottest month with mean daily maximum temperature of 41.3° C and minimum of 26.5° C. Nights are warmer in June than May, with the onset of monsoon by third week of June day temperature decreases appreciably.

(b) RAINFALL

The average annual rainfall in the district is 647.3 mm. The rainfall increases from South west towards the north-east and varies from 60.4.5 mm at Hathras to 724.9 mm at Iglas. About 87% of the rainfall is received during the South-west monsoon. Months from June to September.

Table - 1

MEAN MAXIMUM-MINIMUM TEMPERATURE

(Jan. 1988 - Dec. 1988)

S.No.	Months	Maximum (°C)	Minimum (°C)
1.	January	21.7	7.2
2.	February	25.1	9.9
3.	March	30.6	13.2
4.	April	39.2	20.3
5.	May	42.9	26.2
6.	June	38.8	25.2
7.	July	33.6	27.2
8.	August	32.4	24.6
9.	September	35.1	21.6
10.	October	32.7	18.0
11.	November	29.4	13.2
12.	December	23.6	9.1

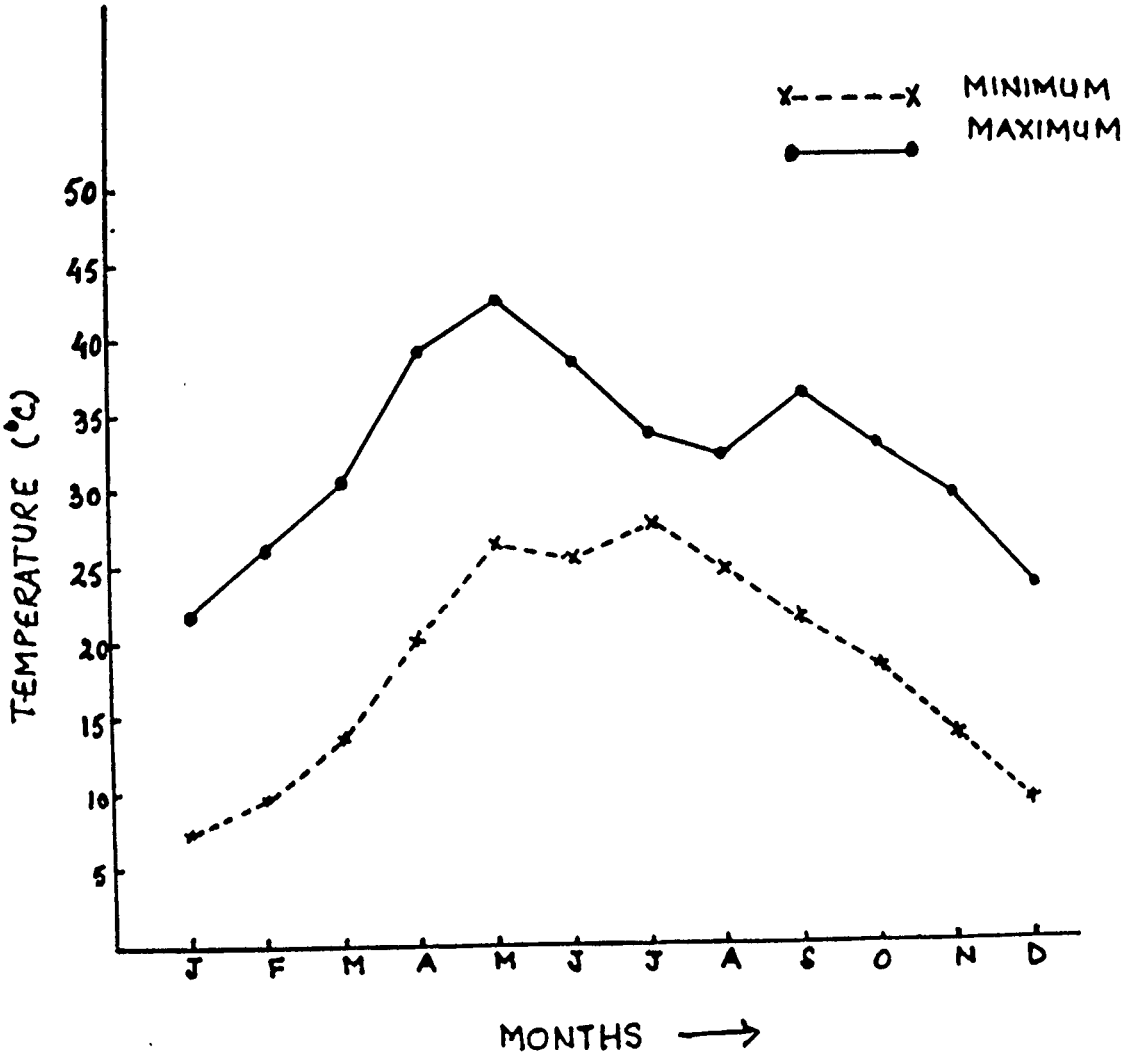


Fig.3 : Monthly minimum - maximum temperature (°C), 1987-88.

July & August being the month of maximum rainfall. The average annual rainfall for 1988 is given in Table (2) shows the months of maximum rainfall to be July and August.

(c) HUMIDITY

Except during the south west monsoon season when the humidity is high the air is generally dry over the district. The **driest** part of the year is the summer season, with less than 25% of relative humidity in afternoon (Table-2).

VEGETATION

The total forest area in the district was about 1,769 ha. in 1976-77 of which 800 ha. was under the control of forest department. Most of the species planted are dry deciduous. The rest of area contains scanty and sparse natural vegetation which includes tree like Prosopis specigera, Acacia leucopholea, Acacia nilotica, Azadirachta indica, and shrubs namely Capparis decidua/specigera, Dichostachys cineres (kan) Grevia hevescens (Chapal), Crotoaria sp. (Bans) and grasses like Desmostachya bipinata (Dub), Erianthus munja, (munj), Erianthus spontaneum, Saccharum munja Saccharum spotaneum. Planted species like Dalbergia sissoo, Eugenia jumbolana, Albizzia lebbek (Siris), Pongamia glabra etc.

Table - 2

AVERAGE TEMPERATURE, RAINFALL HUMIDITY

(Jan 1988 to December 1988)

S.No.	Month	Temperature (^{o}C)	Rainfall (mm)	Humidity (%)
1.	January	14.4	1.6	84.5
2.	February	17.5	10.2	71.2
3.	March	21.9	12.0	62.5
4.	April	29.7	9.03	41.8
5.	May	34.5	1.54	38.2
6.	June	32.0	52.68	62.7
7.	July	30.4	262.21	85.5
8.	August	28.5	421.79	85.6
9.	September	28.3	68.70	76.9
10.	October	25.3	26.53	72.0
11.	November	21.3	1.4	73.0
12.	December	16.3	22.4	78.1

MAIN STUDY AREA

The three main study areas of Aligarh fort University Agricultural farm and Panjipur (Fig.4) consists mainly of agricultural crop fields and some plantation. The most common tree species in the fort area comprises of planted trees like Terminalia arjuna Sterulia urens, Pongamia glabra, Ficus benjamina, Thespia populinea, Kigelia pinnata, Delonix regia, Pterosperum acerefolium, Callistemum lanceolatus, Tectoma grandis. Among the naturally grown trees Azadirachta indica is the most common tree, which alongwith the Delonix regia and some Dalbergia sisoo provides the maximum nesting and roosting sites for the roseringed parakeets. Among shrubs Prosopis specigera, Prosopis julifera, Capparis are fairly common. Other shrubs like Carissa sp., Plumeria durnta are frequently seen. The grasses which are common, are doob Cynodon dactylon, Desmostachya bipinnata and a patch of lemon grass Cymbopogon citratus. Cypress rotundus is the most common species among the sedges.

The areas of Kila Ka Nagla which is close to the University fort and Panjipur, mainly consists of agricultural fields with some plants of Prosopis specigera and on the edges of field grass like Saccharum spontaneum are common. Area of University Agricultural farm consist of mainly agricultural

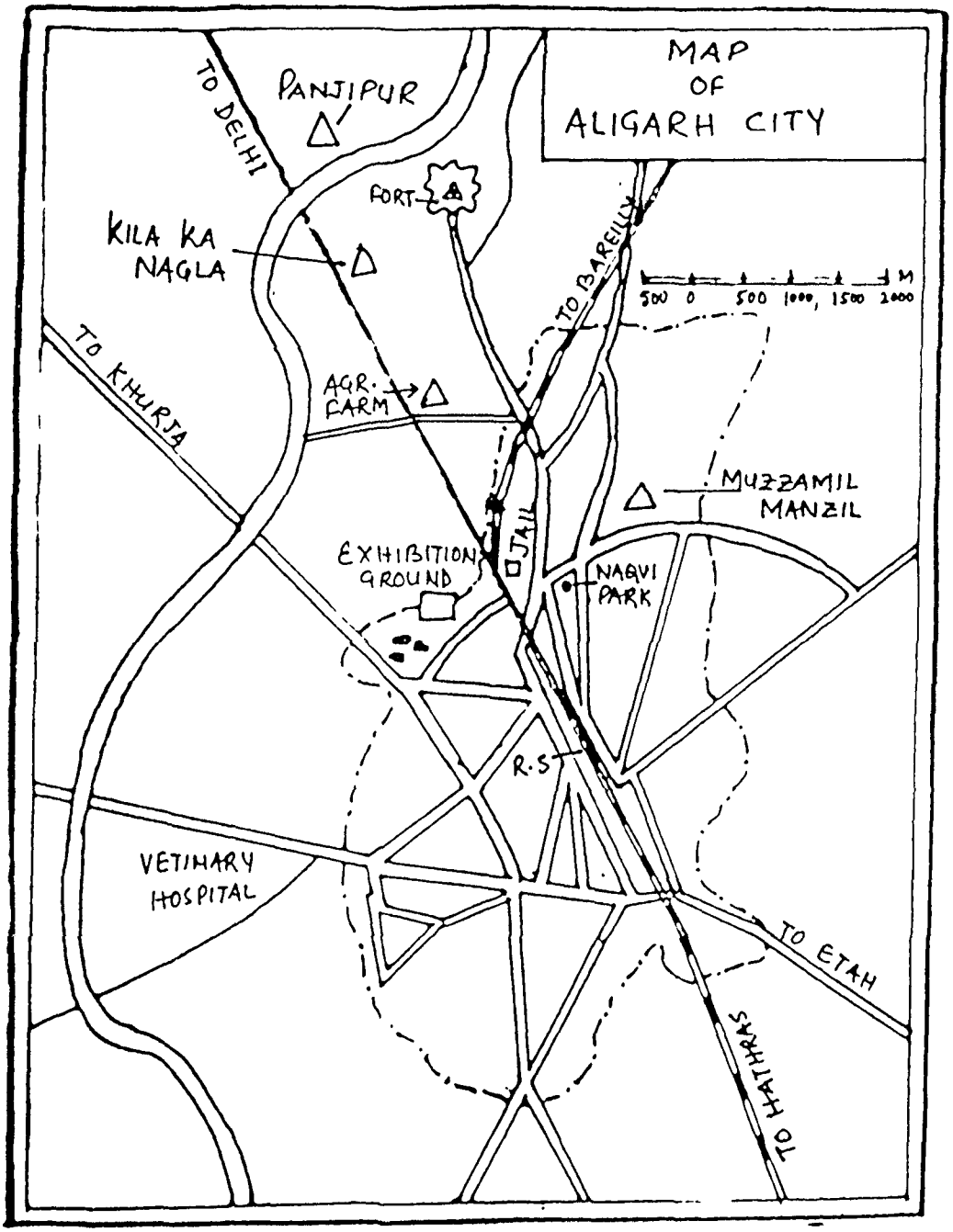


Fig.4 : Map showing main study area (△) and (●) roosting sites of parakeets.

crop fields and plantations of guava Psidium guajava and Kinno, Citrus sp. and some trees of Neem Azadirachta indica, Dalbergia sissoo, and grasses like Cynodon dactylon, Saccharum spontaneum. There is no natural vegetation around the study areas.

FAUNA

The area is not diverse as regards to fauna, largely because of agricultural practices and human settlements. The common animals seen in the area are mongooses (Herpestes edwardsi); palm squirrel, (Eunambulus pennanti) and some bats among the mammals. while reptitians are represented by cobra (Naja naja), Krait (Bungarus caeruleus), rat snake (Ptyas mucosus) which is fairly common in the area alongwith some lacertilians such as Calotes versicolor and monitor Lizard, (Varanus. sp).

Avifauna is better represented in the area most common among those are the birds associated with agriculture and orchards viz. Rose ringed parakeets, the common myna, the pied myna, the common house sparrow, the blue rock pigeon, little brown and ring doves, the bulbul. A full checklist of the fauna of the area is given in (Appendix-I).

METHODOLOGY

For studying food and feeding habits of parakeets 6 X 30 field glasses were used to record the observation in the field. The work started in January 1988 and was carried out till January 1989. The areas for intensive study were selected around University campus for easy access. The two main areas of University Agricultural Farm, and area near University fort were selected for taking observation on crop fields (Fig.4). The fields were selected keeping in mind the distance of the fields from the nearest roost. Manikowski & Smeets (1984) also observed these factors for damage assessment in millet & sorghum in Chad. All the crops occuring in the area, their sowing and harvesting times were recorded to know the availability of different food items for parakeets in different months. Phenology of common fruiting trees which occur in the campus and are used by parakeets was recorded. All those trees used by parakeets were observed for feeding by parakeets and listed accordingly.

For behavioral studies observations were taken in four hourly shifts as done by Yahya (1980) in Periyar. The three shifts, morning (from 0006 hours to 1000 hours), noon (from 1000 hours to 1400 hours) and evening shift (1400 hours to 1800 hours) were done on alternate days.

For obtaining information on feeding session, record on the number of birds at few selected points were taken and all the birds seen and the birds actually seen feeding were noted to know the frequency of feeding & shift preference or feeding session if any. The observation on fruit damage were taken regularly from 15th January till 20th March. To quantity the damage on the fruits random sampling was adopted as by done Ramzan & Toor (1972), Toor & Sandhu (1981), Sandhu & Dhindsa (1981).

Out of 147 trees in the orchard 30 trees were selected at random & 10 each on the periphery of the orchard & 10 in the middle of the orchard. Each tree was then was marked for damage assessment. Four branches were again selected in each tree for regular monitoring of damage, two in the upper canopy & two in the lower canopy. Number of fruits on each branch was counted in the beginning

and on every monitoring, the number of fruit was checked and sign of damage recorded.

Damage was categorised on the basis of visual observation in five categories:0 - 20%, 20-40%, 40-60%, 60-80%, 80-100%, but percentage damage was calculated on the basis of fruit eaten or damaged to the fruits without any damage. Average fruit per branch was calculated by counting the number of fruits on each branch & adding the total and dividing by four to get the average. The number of branches in each tree were counted. The average number of fruits per branch was counted and then multiplied by the total number of branches on each tree to get cumulative figure of fruits on a tree. Similarly average fruit damage per branch was used to extrapolate the number of damage on a tree, the fruits per tree and average fruit damage. To get the total damage of fruits in the orchard average damage on one tree was extrapolated for the whole orchard.

To know whether there is a significant difference between the damage on upper branches and that of lower branches the data were tested statistically. Product moment correlation (PMC) was used to find out correlation between the damage on the two upper and two lower branches and later the results were tested by students t-test.

$$r = \frac{n \Sigma(xy) - \Sigma(x) \times \Sigma(y)}{\sqrt{(n. \Sigma(x)^2 - (\Sigma x)^2 \quad (n. \Sigma(y)^2 - (\Sigma y)^2}}$$

For knowing the reliability between the actual sampled data and the extrapolation for the whole orchard, Wilcoxon's Test for Matched pair was tested. Initial phase of the study was utilised in throroughly identifying the damage done by parakeets only. This was achieved by direct observation (observing birds feeding on fruits and crops) in the field and then identifying it. For this the fruits, cobs and earheads which were fed by the parakeets were photographed and details of method of damage were recorded, like the depth of the wound and average size of the nibbled and gnawed parts of fruits which were dropped during feeding. The depth of wound and size of dropped part is important for identification (Shafi et al,1984). The observation were taken using Ad-libitum and focal animal sampling methods (Lehner 1979). Notes were taken on the roosting site, trees for perching and other information like scaring manual or mechanical and interviewing the farmers.

To study the feeding behaviour of roseringed parakeet on crops and damage incurred to them, three intensive study areas were selected (Fig.4). The area of University

Agricultural Farm, Kila Ka Nagla, Panjipur were selected for damage assessment. The areas were selected keeping in mind the roosting sites of roseringed parakeets. The observation in the fields of Zea mays, and Pennisetum typhoides were taken regularly, right from the sowing stage by doing shift wise observations. The three fields of Pennisetum typhoides were 50 X 50 mtrs (0.25 hectares) each. The three fields were 300, 200 and 500 metres away from the roosting site of roseringed parakeet. The fields were walked in fixed transects from edge to edge, Manikowski & Smeets (1984), Schmid & Hawa Muse (1988). Each Penisetum typhoides field (50 X 50 mts) was walked at five points and at every 10 meters (15 steps) one sampling was done. In all there were 25 sampling points, and at each sampling point 5 earheads were randomly examined for probable damage. In all 125 earheads were sampled in different damage class. This was done just before the harvest to get the total damage. Each site was observed for roosting site, trees in the vicinity, scaring, variety of the crops, weediness and diseases besides interview with the locals about crop damage and other informations.

The two maize fields which were sampled for damage assessment were 200-500 mtrs away from the roost. The two fields of area 75 X 50 mtrs (0.375 hectares) were sampled for damage assessment.

There were 15 rows along the length and 5 along the width of the plot. Each row had 5 sampling points and at each sampling point 5 plants nearest to the point were observed for damage. In all there were 75 sampling points and a total of 375 plants were sampled for the degree of damage. On the basis of visual estimation the damage to cobs were classified in different damage categories 0=no damage, 1/8 = upto 12.5%, 1/4 = upto 25%, 1/2 = upto 50%, 3/4 = upto 75% and 1 = upto 100%. All the plants with cobs at each sampling points were counted and noted. The number of damaged cobs were grouped in each damage class accordingly. Overall cob damage in different class was put together to get the number of cob damage in a row, and the percent loss was calculated by dividing the total cob damage in a row by total number of cobs per row. The percent loss in the plot was then summed up to get average damage in the sampled plot.

Phenological observation were taken regularly on weekly basis and record of flowering and fruiting of common species were maintained which were supposed to be utilised by the parakeets. The sowing and harvesting times of major crops were maintained.

For control measure bird scaring reflecting tape were tried in two sample plots 25 X 25 meters in the bajra fields. The reflecting tape is a synthetic resin film made with metallic red and silver surfaces on the two sides. It was suspended over the crop field by tyring it on the bamboo poles (Fig.9). It reflects light through its shiny surfaces and in windy conditions produces humming sound. Besides this other factors like distance of field from the roosting sites and effect of varietal characters were observed to suggest a suitable control measure.

CROP REGIMEN

India's economy to a large extent depends upon the agriculture which is still the most common occupation of majority of Indians in general and rural people in particular. Some do it for subsistence while some do it for capital gains. With the advancement of science great mechanisation in farming has taken place and years of research has produced various hybrid, disease resistant and high yielding varieties. This has raised country's agriculture production to manifolds and boosted the economy.

The diverse soil type, topographly and distinct climate in different regions are responsible for the particular crop type & cropping pattern in the area. Inspite of all the advancement and better irrigation facilities the crop type of an area is largely influenced by its climate besides various other factor which equally play an important role in the cropping pattern of the area.

Aligarh region which falls in the upper ganga plain is characterised by tropical monsoon type of climate (Singh 1987) which determine the crop type in the area and its pattern. As the present study was carried out in this region on feeding habits of parakeets and its impact on agricultural crop it became important to know the cropping pattern, the seasonality and other aspects for the overall crop regime of the area. The cropping pattern has been variously described which is the proportion of area under various crops at a point of time. The 1960 committee constituted by the Government of India recognised the cropping patterns according to relative acerage of various crops in a district or in an area (Agriculture situation 1964). Cropping pattern in a true sense means the time duration for which a crop is grown and total area occupied by the crop and it includes most commonly grown crop, the intensity, the crop rotation and the crop combination.

The cropping pattern in Northern India is characterised by two distinct seasons Kharif (July - October) and Rabi (October - March). The crops cultivated in the intervening period of March and June is zaid which mostly consists of vegetables and some crops (Table-3). Some crops are grown mixed i.e. mixed cropping or changed in rotation (rotational cropping). Depending upon the soil fertility, monocropping (one crop during one season) double cropping (two crops in a

this the socio-economic status, cultural practices, climatic conditions, traditional cropping, land size, personal preferences, resources and individuals effort contribute cumulatively to the total cropping pattern of an area. Crop occupying the highest percentage of area in the region is considered as base crop and other crops are included in the cropping pattern. On the basis of this the two well defined cropping pattern. i.e. Kharif based cropping pattern and Rabi based cropping pattern are recognised and further subdivided into the main crops of each season.

The Kharif based cropping pattern includes rice based, jowar based, millet based, maize based cropping patterns, while the rabi based cropping pattern includes wheat based gram based, jowar based and mustard based (ICAR 1987).

On the basis above mentioned criteria the cropping pattern i.e. Kharif cropping patterns includes maize based and bajra based cropping patterns.

MAIZE BASED CROPPING PATTERN

It consists of maize as the base crop and wheat is the alternative crop in Rabi season and bajra is the alternative crop in the Kharif season and in the intensive

Table - 3

AGRICULTURE YEAR IN ALIGARH

S.No.	Kharif (Jul - Oct)	Rabi (Oct.-Mar)	Zaid (March-June)
1.	Maize	Wheat	Cucurbits
2.	Bajra	Rye	Summer vegetable
3.	Jowar	Mustard	Water Melons
4.	Rice	Barley	Kakri
5.	Urd	Pea	Khira
6.	Moong	Gram	Legumes
		Arhar	
		Masoor	

study area 31.7% of the fields were under maize cultivation.

BAJRA BASED CROPPING PATTERN

Aligarh region is known for bajra crop which is highly preferred by the farmer due to its being hardy and drought resistant, which suits to the dry and low rainfall area of Aligarh. Under the bajra based cropping pattern jowar and maize from the alternative crops in the area. In the intensive study area 36.5% of the fields were under bajra cultivation.

The Rabi cropping pattern mainly consists of wheat as the base crop and in the intensive study area 24.3% of the fields were under wheat. In the area wheat is occasionally followed by jowar and gram as the alternate crops.

Distinct seasons determines the seasonality of crops. The Kharif crops mostly falls in monsoon period, most of the Kharif crops are sown in June end and harvested by September - October. The Kharif crops include Bajra, Maize, Rice, Jowar, Urd and Moong. The maximum productivity is of Rice followed by bajra (Table-4). The Rabi crops are sown in October-November and harvested by March-April. The common

Table - 4

PRODUCTIVITY AND AVERAGE YIELD OF KHARIF CROPS

(1976 - 1977)

Season	Crops	Area sown	Total Production in Tonnes	Average Yield Per Hect. (Quintol)
Kharif Sowing (June-July)	Bajra	111,049	91,060	8.20
	Maize	72825	44,787	6.15
	Rice	73231	16,373	12.37
	Jowar	3154	426	1.35
Harvest (Sept-October)	Urd	494	78	1.58
	Moong	225	55	2.47

Table - 5

PRODUCTIVITY AND AVERAGE YIELD OF SOME RABI CROPS

(1976 - 1977)

Season	Rabi Crops (Hect.)	Area sown (Hect.)	Total Production (Tonnes)	Avg. Yield/ Hect. (Quin
Rabi	Wheat	2,01,970	375,058	18.57
Sowing (Oct.- Nov.)	Barley	62,065	85,457	13.93
	Pea	34,675	39,783	11.43
	Gram	15,764	19,500	12.37
Harvesting (Mar- April)	Arhar	3,363	14,885	44.26
	Masur	1,643	628	3.82

Table - 6

PRODUCTIVITY AND AVERAGE YIELD/HECT. OF NON-FOOD CROPS

(1976 - 1977)

S.No.	Crops	Area Sown (Hect.)	Total Production (Tonnes)	Avg. Yield/Hect. (Quintal)
1.	Sugarcane	17,434	6,78,296	389.07
2.	Ground nut	917	474	5.17
3.	Mustard	3,230	1,377	4.26
4.	Oil seeds	4,242	1,860	-
5.	Cotton	6,230	523	0.84
6.	Potato	2,912	3,7993	130.47

Rabi crops include wheat, barley, pea, gram, arhar and masur. Arhar is most productive followed by wheat but area is maximum under wheat (Table-5).

On the basis of acreage and total cropped land under each crop the main crops of the area are wheat, maize, bajra, pea and gram. Out of the total 501583 hectares area of the district 391032 hectares is under cultivation, 11055 hectares under fallow land (Table-7). Wheat occupies the largest area under cultivation with 227599 hectares, followed by Bajra 76899 hectares. The other important crops and area under each are listed in(Table-8).

In the whole upper ganga plain main crops are maize millet, wheat & pea. Maize & millet share about 16.8% of the total cropped land in the region and Aligarh contributes 19.5 to the 7% of the total crop land under bajra in the upperganga plain. Maize follows next with 6% of the total crop land and Aligarh contributes 8.1 to it, (Singh 1987). There is significant production of wheat in the area but rice and sorghum occupies lesser cropped land. Among pulses production of peas is significant. The greater diversity of the cropping pattern is provided by Kharif (Urd, moong, arhar) and Rabi (gram, pea, masoor pulses. Gram (12.0) and pea (4.6) together constitute about

Table - 7

LAND UTILISATION IN ALIGARH DISTRICT

S.No.	Utilisation of Land ofor various purposes	Area in (Hectares)
1.	Total Area of the district	501583
2.	Area under cultivation	391032
3.	Area under fallow land	11055
4.	Culturable land (under forest grove, waste land)	4621

Table - 8

AREA UNDER PRINCIPAL CROPS IN THE DISTRICT

(1987 - 1988)

S.No.	Crops	Area under each crop (Hect.)	Total area of the district (Hect.)	Area under cultivation (Hect.)
1.	Wheat	227599		
2.	Bajra	76889		
3.	Maize	-		
4.	Barley	44750	501583	391032
5.	Gram	12115		
6.	Paddy	9488		
7.	Pea	18520		
8.	Jowar	746		

1/6th of the total croppedland. Aligarh contributes a major 12.7 portion of the peas production in the region (Singh 1987).

During the course of this study in the intensive study areas of Panjipur, Kila Ka Nagla and University Agricultural farm fields were selected and were monitored throughout the year and in different season to know about the frequency of crops grown. Bajra 36.5% followed by maize 31.7%, wheat 24.3% mustard 4.8% were under the cultivation in the two seasons. The cropping intensity index is higher in the upper doab & most of the districts of Awadh plain as compared to the state as a whole. Like the yield per area the cropping intensity is dependant on the physical and cultural factors. Aligarh with its physical factors and other factors like labour etc. has low productivity which is to some extent is compensated by better irrigation facilities. The average yield per acre in 1987-88 was highest in case of wheat 25.55 q/h and lowest in case of Jowar with only 5.12 q/h (Table-9).

The crop combination in the area is typical of the region. Bajra claims first position in Aligarh & is most intensively grown crop in the study area. In the area bajra is grown as a single crop and also as a mixed crop with till and arhar. In the study area two fields of bajra were under

Table - 9

AVERAGE YIELD/HECTARE OF SOME OF THE IMPORTANT CROPS OF THE AREA (1987 - 1988)

S.No.	Crops	Average Yield/Hect.
1.	Wheat	25.55 q/h
2.	Barley	20.06 q/h
3.	Paddy	18.81 q/h
4.	Pea	12.67 q/h
5.	Millet	11.23 q/h
6.	Gram	8.19 q/h
7.	Rai/Sarson	7.67 q/h
8.	Maize	5.99 q/h
9.	Masoor	5.26 q/h
10.	Jowar	5.12 q/h

mixed cultivation with till. Wheat is generally grown as single crop and occasionally grown with rye. Mustard is generally grown as a single crop in the area but in the study area frequency of field under mustard crop was very low 4.8%.

CROP ROTATION MIXED CROPPING

In past to leave the field without crop for a season to allow the land to recuperate its fertility was practised. But of late crop rotation and mixed cropping are proving more beneficial. Development of non-agricultural techniques and use of pesticides have increased the overall yield. The most common rotations being practised in the area are maize-wheat, maize-potato, paddy-wheat, maize early, potato late, bajra-wheat, green manure (barseem)- wheat.

The system of mixed cultivation not only gives additional harvest in the same field thereby increasing the overall yields, but also ensures optimum utilisation of the land, the nutrients and other agricultural inputs. The leguminous crops like moong with other cereal crops help in providing nitrogen to the soil and through it to the standing crops. Apparently for this reason arhar is mixed with jowar, urd, til; bajra with urd, arhar, til.; wheat with gram, pea and mustard barley with gram or pea, maize with urd.

IRRIGATION

The district enjoys exceptionally good irrigation facilities. Even before the introduction of canals, the natural advantage of tracts were far more greater than in many parts of the doab. Wells are the most important source of irrigation in the area. Inspite of great expansion of canal system, wells including tube wells, still form the chief source of irrigation about 47%. The crops get regular supply through it. The area irrigated by canal is 94,33 hactares and the area irrigated by tube-well is 23855 hectares and other source 1191 hacteres (Aligarh Gazetteer 1989).

SOIL NUTRIENTS

The traditional manure are cattle during farm refuse and stable litter. The usefulness of green manure crop such as dhaincha, sanai, barseem and moon which increase the soil fertility by providing nitrogenous matter to the soil is being largely practised. The use of chemical fertiliser is quite favoured by the farmers of the area. The nitrogenous, phosphatic and potassic fertilizers are most commonly used fertilisers in the area (Table-10).

Table-10

COMMONLY USED FERTILIZERS IN THE AREA

S.No.	Fertilizers	Quality distributed in tonnes (1976-77)
1.	Nitrogenous	12948
2.	Phosphatic	3945
3.	Potassic	1898

Though there has been tremendous advancement in the agriculture sector but still most of the crops are plagued with the problem of avarious insects and vertebrate pest species. The infestation by insect pests greatly affects the production of the crop and if it remains unchecked it seriously curtails the yield/hectare. With the use of some very effective pesticides and introduction of disease resistant varieties there has been considerable decline in the pest infestation.

The problem of vertebrate pest and in particular the avian pests species which is fast becoming a serious threat to farmers in many parts of the country. Depredatory species like rosy pastors, stalings mynas, sparows are doing severe damage to crops in Punjab, Haryana, parts of Uttar Pradesh.

In Aligarh region sparrows, parakeets, mynas weaver bird are problematic to farmers and orchard owners. The farmers have little in their hand to solve this problem, they still resort to the old age practice of scare crow and drum beating which is not very effective as birds get easily used to it. So there is urgent need to work out such problems and suggest control measures for this problem. The present study was envisaged with this idea in mind and it will be discussed in the next chapter.

RESULT & DISCUSSION

The northern roseringed parakeet feeds upon fruits and seeds of number of crops (Ali & Ripley 1969). This bird feeds upon fruits like Psidium guajava, Mangifera indica, Zizyphus jujuba, Terminalia arjuna and many other fruits (Table-11). Among the crops it feeds upon bajra, Pennisetum typhoides, jowar, Sorghum Vulgare, wheat - Triticum aestivum, maize, Zea mays and other crops like mustard, alsi etc. The wide range of food items consumed by the roseringed parakeet speaks of its diverse feeding habit which are influenced by its morphological,physiological and anatomical features.

Food is essential for life and a large part of animals life and energy is wasted in procuring the desired food item which it can relish and survive. The range of food and its exploitation depends upon anatomical features viz. bill size, sharp mandibles, hooked bill and other features help in the feeding,as in rosergined parakeet. Once the animal gets its food it is the quality of food which becomes important. The basic principle is that food should have more energy rich contents in it so as to compensate for the energy spent in its

Table - 11

FLOWERING & FRUITING TIME OF SOME COMMON TREES IN AND AROUND THE CAMPUS

S.No.	Plant Species (Scientific Names)	Common Name	Flowering	Fruiting
1.	Psidium guajava	Guava	May-June Sept-Oct	Aug - Sept Dec - Mar
2.	Mangifera indica	Mango	Jan-Mar	Apr-Aug
3.	Terminalia arjuna	Arjuna	Apr-May	June-July
4.	Eugenia jumbolana	Jamun	Apr-May	June-July
5.	Acacia nilotica	Babool	Nov-Feb	Apr-June
6.	Embelica officinalis	Amla	Aug-Sept Feb-Mar	Nov-Dec Mar-Apr
7.	Kigelia pinnata	Lookiya	Apr-May-June	Nov-Jan June-Oct
8.	Azadirachta indica	Neem	Mar-May	May-Jul
9.	Melia azadirach	Bachain	Mar-Apr	Sept-Nov
10.	Leucamia glauca	Safeda	June-Aug	Oct-Feb
11.	Aegel marmelos	Bael	Mar-Apr	May-June
12.	Tamarindus indica	Imli	June-Sep	Aug-Dec
13.	Delonix regia	Gulmohar	Mar-Apr	May-July
14.	Zizypus jujuba	Jharber	Aug-Nov	Jan-Feb
15.	Dalbergia sisoo	Shisham	Feb-April	Apr-May
16.	Punica granatum	Anar	Apr-June	Sept-Nov
17.	Bombax ceiba	Semal	Jan-Mar	Apr-May
18.	Ficus carica	Fig	Mar-Apr	May-July

procurement. This depends upon animals ability and intelligence to get its food with minimum effort. Resources procurement and foraging ability depends upon availability and distribution of resources. If the resource, is sparsely distributed and away from animals easy access it will be at the expenditure of greater energy on part of animals.

The northern roseringed parakeets are completely phytophagous birds and at no stage they feed upon the insect food item not even at the nestling stage, when most of the bird feed their young with high protein rich insect food items. Though the Nicobar Parakeet, Psittacula longicauda has been found to feed it's nestling with insect food (S.A.Hussain Pers. Comm.).

FOOD AVAILABILITY

Table (11) shows different food items available for parakeet round the year, based on the phenological observations taken in the field. The phenology of different fruiting trees and sowing and harvesting time of crop are important for food habit studies.

In January and February the fruits of guava, Psidium guajava comprises the main diet of parakeets as the maximum concentration of parakeets were observed in the guava orchard.

The other fruit items available for parakeets during these two months are Embelica officinalis, Zizypbus jujuba, Kigelia pinnata and pods of Acacia nilotica and Delonix regia, but these food item are used more frequently after the guava Psidium guajava fruits are over which extends upto late March. By the end of March crops like wheat Triticum aestivum, mustard, Brassica compestris are available. Wheat crop is harvested by mid April and by that time fruiting in Mango, Mangifera indica starts which stretches upto July. But other food items available during this period are fruits of fig Ficus carica, pods of Acacia nilotica, Pisum sativum which extends upto May-June when fruits like Kigelia pinnata, Terminalia arjuna, and Indian cherry Eugenia jumbolana starts fruiting. By the end of August most of the fruits are over but guava Psidium guajava gets it seond crop but it does not constitute major portion of parakeet diet as in the winter crop, which is due to high infestation of fruits by fruit fly Dacus zonatus. By the end of October crops like maize Zea mays from milky to dough cob stage and jowar, Sorghum vulgare are ready alongwith Sesamum indicum are used by parakeets till the end of October and beginning of November. By the mid November bajra crops gets its earhead which alongwith alsi and jowar are available till December before being harvested. In November and December the fruiting in Embelica starts and along with Delonix regia it extends upto January and February. During this period most of the bird feed upon these fruits and some

fields harvesting is late due to delayed sowing.

The seasonal changes in parakeets diet paralleled changes in the relative abundance of various foods and the diet becomes restricted in winter when most of the crops are over and fruiting in most of the tree starts.

The phenological observation (Fig.5) show that overall fruiting is low from January to March where only fruits like guava are available. After March fruiting in good number of trees start and it reaches its peak May-June where 8 to 9 species get fruits, then it drops down from 7 in July to 3 in August. The maximum fruiting from April to July when most of the crop fields are under plough or with maize crop which starts getting grain in August-September. The lean period from the seeds point of view is compensated by abundant food in form of fruits during the month of April-May, June-July. Though in January-March when fruiting is low the guava fruits are lightly preferred by parakeets. They are not frequently seen in other crop fields such as wheat and mustard which are available by March.

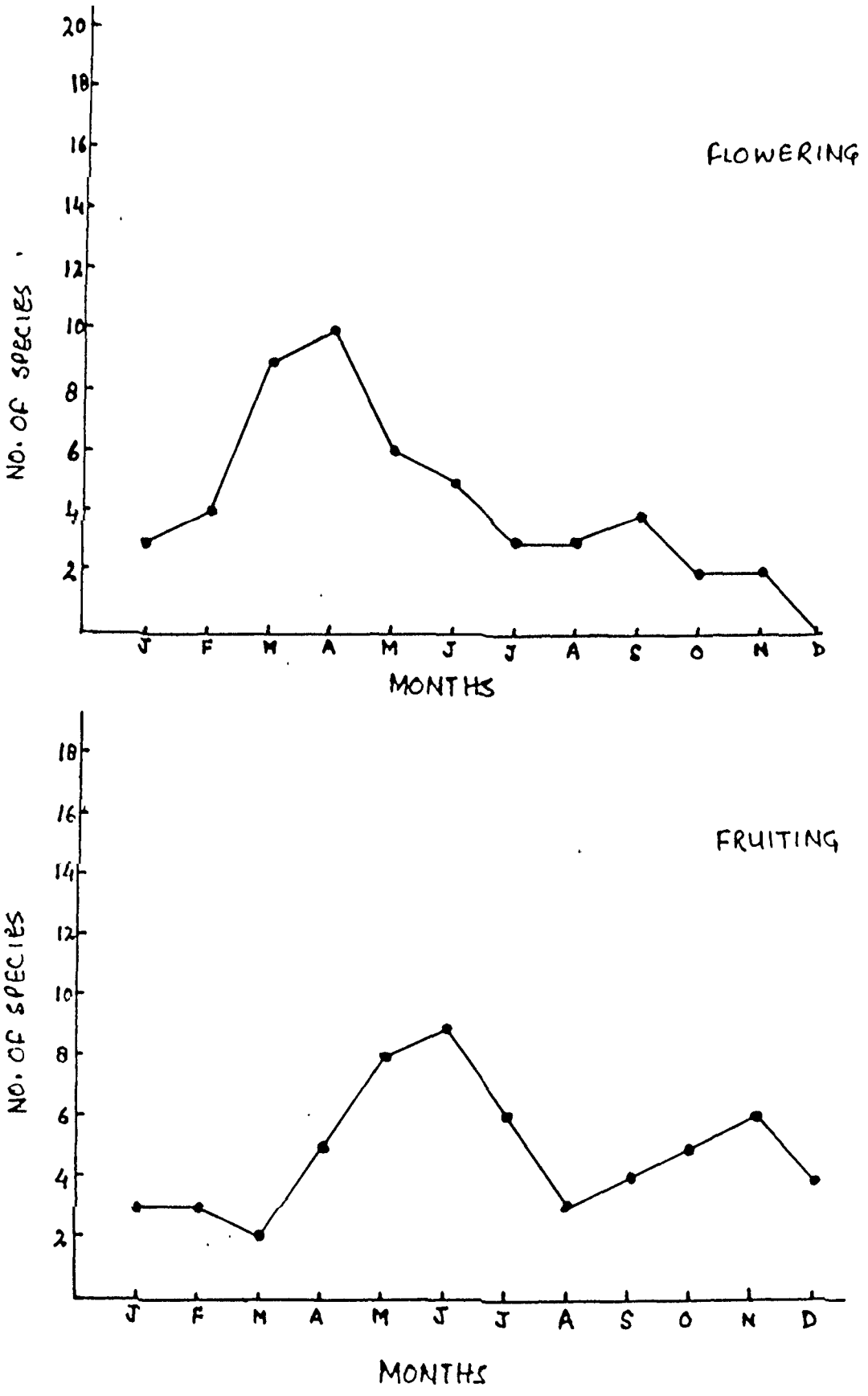


Fig. 5 : Phenology of some of the common trees in and around the study areas.

FEEDING ACTIVITY

The roseringed parakeets are group feeder and their feeding activity depends upon the social organisation. Gregarious feeding enhances the chances of location of food especially in the lean period by a behavioural mechanism "Local enhancement" (Hinde 1961), where the attention of some individuals is drawn to a food source discovered by others. But this is only advantageous when the amount of food available is greater than can be immediately consumed by the birds that locate it.

The communal roosting and vociferous nature in parakeets is advantageous in food location and its utilisation as they feed upon diverse food items - such as crops and fruits which are sufficient enough in the area to support a large population without any threat of exhausting their food resources. The activity of parakeets commences at dawn when they start leaving roosts in large flocks and more towards their feeding ground in noisy parties. The birds once they start feeding they become quiet and intensively feed upon after sunrise. The plumage comonflages the parakeets in the green foliage and it is difficult to locate them unless observed very keenly. In the guava orchard they can be

noticed while feeding by a faint sound which is produced due to meeting of two mandibles while cutting the fruits particularly the harder ones or by observing the graved portion dropped down from the cutting of the fruit.

The feeding reaches its' peak around 0080 hrs. to 009 hours though it continues further. Repeated shiftwise observation in the guava orchard shows that they are most active in the morning shift 80.7% (Fig.6). The apparently high feeding in the noon shift, when it greatly declines, is probably due to nearby perching trees which provide shelter to birds during day time and also due to decrease in intensity of scaring which make the feeding easier. Birds once out in their feeding areas spend maximum time in feeding. Out of 498 observation in Guava orchard 64.8% were on active feeding. The average feeding time in a stretch was 5 minutes after when birds either flew off to another tree or to a nearby perch before appearing again in the field. They feed voraciously during this period and consume about 20-30% of the fruit in one feeding.

The feeding activity in crop fields also commences at the dawn but in comparison to guava orchard there was virtuall no feeding during the noon shift but morning and evening feeding were as ctive. The maximum flock of bird was 31 in the bajra field in morning session while in guava orchard they were never seen in large flock and the maximum flock was 11 at one occassion during the study.

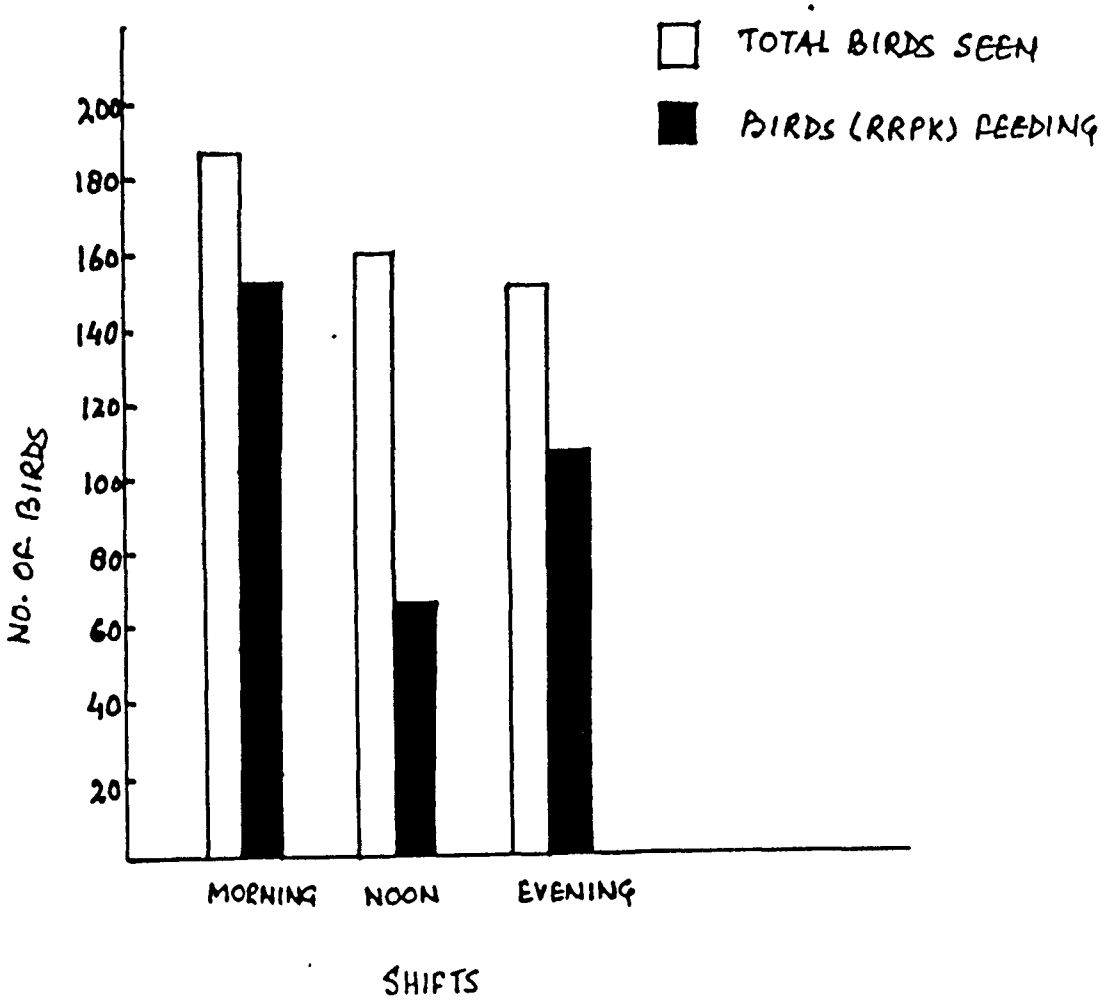


Fig.6 : Frequency of feeding in different shifts by roseringed parakeet in the guava orchard.

FEEDING METHOD : RELATIONSHIP BETWEEN MORPHOLOGY ANATOMY AND FEEDING HABIT.

Animals' morphological and anatomical features play important role in the successful existence. The northern roseringed parakeet feed upon different plant food item comprising of a wide array of plant parts such as seeds, fruits, pods, leaves, nectar and tender leaves (Table 12). The diverse food items of roseringed parakeets reflects the adaptation which contribute in feeding upon different food items efficiently. The most obvious adaptations in parakeets which enables them to cut hard unripe fruits, tear apart the bracts of cobs, rip open the pods for seeds, are due to their strong and hooked upper mandible loosely articulated with skull (Ali & Ripley 1969). These specialisation along with skull capable of kinetic movement accentuates the feeding. The zygodactylous feet in parakeets adapted for clambering upon branches with great ease also helps in holding the fruits for feeding. Some finch species use their feet in coordination with their bill to obtain food (Newton 1967).

The observations taken in the guava orchard and on crop fields shows the different strategies were adopted by parakeets to feed upon different food in different cirumstances.

Table - 12

FOOD SPECTRUM OF ROSERINGED PARAKEETS

S.No.	Plant Species (Scientific name)	Common Name	Parts eaten	Degree of
1.	Zea mays	Maize	S	+++
2.	Pennisetum typhoides	Bajra	S	+++
3.	Triticum aestivum	Wheat	S	+++
4.	Sorghum vulgare	Jowar	S	+++
5.	Brassica compestris	Sarson	P	++
6.	Oryza sativa	Rice	S	+
7.	Pisum sativum	Pea	P + L	+
8.	Psidium guajava	Guava	F	+++
9.	Cicer arietinum	Gram	P+L	+
10.	Mangifera indica	Mango	F	+
11.	Embelica officinalis	Amla	F	+++
12.	Terminalia arjuna	Arjuna	F	++
13.	Eugenia jumbolans	Jamun	F	+
14.	Acacia nilotica	Babool	P	+
15.	Azadirachta indica	Neem	F	+
16.	Delonix regia	Gold Mohur	P	+
17.	Leucamia glauca	Safeda	P	+
18.	Kigelia pinnata	Lookiya	F	+
19.	Bombax ceiba	Semal	FL	+

F =fruit, S + Seeds, P = PODS, L = Leaf, FL = Flower Petal

The ripe guava fruits are cut with its sharp and strong mandibles while the fruit hangs with the pedicel. Some part of the fruit is gnawed and drppped down. The smaller fruits which are unripe are some time cut directly from the stalk by the sharp mandibles or after inflicting two or three injuries on it. The smaller fruits which are not fully ripe are cut from the stalk and held in one foot, generally right and then fed upon by raising the foot and slightly lowering the head and after eating the desired amount it drops down the whole fruit. When disturbed while feeding upon the fruits detached from the tree they fly off to the nearest tree where it is consumed. Foster (1989) categorised the feeding by frugivores in three classes viz. Type I (pluck and swallow feeders), Type II (cut or mash feeder) Type III (Push or bite feeder). The feeding method in norther roseringed parakeet partly fits in Type II where it cuts the pulp of the fruit by piercing its upper mandible into the pulp. The type III feeding where pulp is removed or cut with bill or the use of other anatomical feature i.e. bill in manipulating the fruit.

A very common feature in parakeet feeding is involvement of Type I & Type III categories. While feeding on guava fruits or on wheat spikes parakeet often remove the fruit from the pedicel or spike from the plant (Type I) and then after settling on a nearby perch it is fed upon after being

raised by one foot and lowering the head also (Type III). Or taking small bites while fruit is on the tree attached to pedicel and drops down the gnawed part and a lot is wasted.

Conveniently the roseringed parakeet can be assigned another Type IV (Pluck, cut and push or bite feeder) category.

Initial phase of study was utilised in identifying the fruits eaten by parakeet and how it can be distinguished from that fed by other birds. Direct observation on feeding were taken and then the fruits eaten were observed and photographed. . . The fruits eaten by parakeets have deep cut which is 1-3/4 inches in depth due to its sharp and hooked mandibles, and the portion gnawed and dropped are 1-1.5 cm in length and roughly traingular in shape which is easily distinguishable from fruits fed by other birds such as bulbub. But bulbul generally feeds upon the fully ripened fruits. There is no other species of parakeet in the area, except for 3 sightings of Blossom headed parakeet Psittacula cyanocephala in the guava orchard after which and they were never seen anywhere.

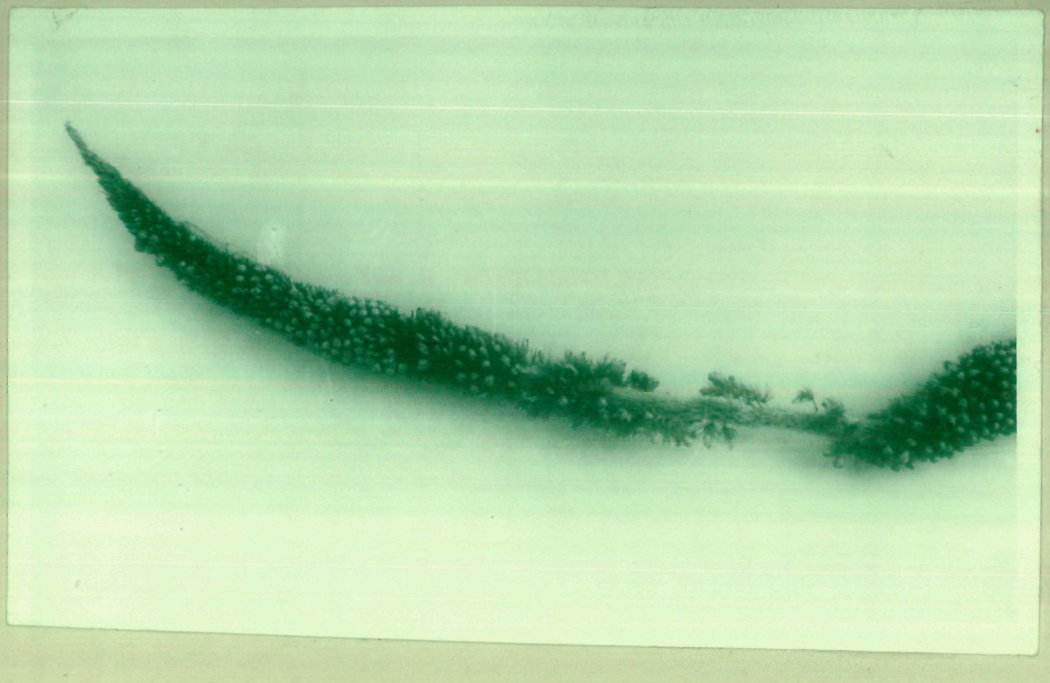
For wheat the method of feeding is different. On account of relatively weak plant parakeets rarely feed upon wheat while sitting on the plant but they always cut the spike on

the wing and take it to the nearest perching tree where it is consumed, before coming to the field again. Due to this reason it was not possible to quantity the damage in wheat field. Maize and bajra crops were attacked from milky to dough stages respectively. The cobs are opened up by removing the leafy bracts, which are cut irregularly by the bill and the silk are also removed before consuming the seeds. By the help of strong and sharp bills it takes out the seed along with the husk exposing the middle axis of the cobs. Bajra earhead damage by parakeets is also easily distinguished by the method of theirfeeding. The earhead are cut along its length (Fig.7) and seeds are taken out alongwith the husk, which is different from that of House sparrows, Passer domesticus and Common Myna, Acridotheres tristis and pied Myna, Sturnus contra. These birds feed grain by grain, picking out single seeds from earheads and cobs. In bajra the sparrows and myna some time feed on half of the grain and the whitish half is left in the earhead or cob, (Fig.10)

DAMAGE ANALYSIS

The random sampling method adopted by Ramzan & Toor (1972), Malhi & Brar (1985, 1988), Halse & Trevenen (1985), was used to quantity the damage in the guava orchard. Out of the 147 trees, 30 trees were sampled;branches, two on

Fig. 7 : Feeding signs of parakeets on the bajra earheads. (Note the exposed stalk characteristic of parakeet feeding).



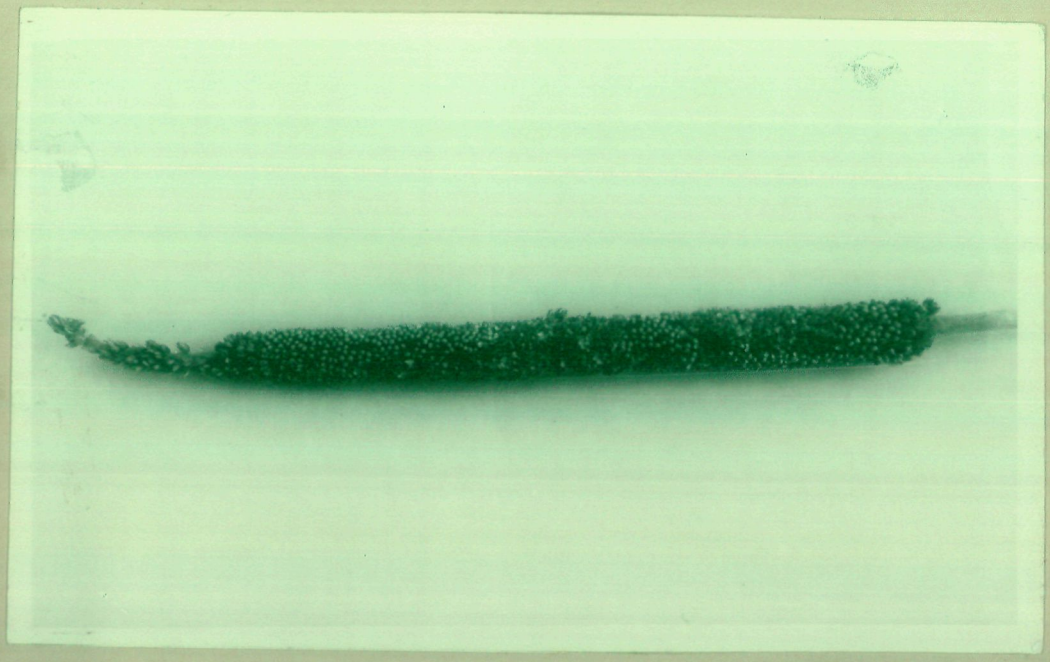


Fig. 8 : Roseringed parakeets feeding on the bajra earheads.


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Fig. 9 : Reflecting tapes in the two sample plots of bajra. A pied bush chat in one of the plot.


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Fig.10 : A common house sparrow and common myna (10A) and pied myna (10 B) feeding in the bajra field.


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upper canopy & two on the lower canopy varied in the degree of damage. The percent fruit damage on the four sampled branches of thirty trees was 19.08%, SD± 4.6 which is quite significant (Table 13).

Damage on the upper sampled branches 22.6% was greater than on the lower branches 15.7% which is significantly greater, (t 4.24 exceeds 2.600 at P= 0.01) (Table-14). The result shows that correlation between the damage on the upper and lower branches is highly significant i.e. that damage on upper branches is significantly more than on the over branches.

The percent fruit damage on the 120 sampled branches when extrapolated for the whole tree was not very different 19.08%, SD± 4.6 on the sampled branches to 18.62% SD±5.1 which is the percent fruit damage for the whole tree. This when tested with Wilcoxon's Test for matched pair, shows that there is no significant difference between the damage on the sampled branches and damage extrapolated for the whole tree, (t = 223, P 0.05-Wilcoxon's Test for matched pairs, (Table-15).

Extrapolated damage on one tree was used to get the total number of fruits in the orchard and the total number of fruits damage. There were 44100 fruits in all out of which 8379 fruits were damaged by parakeets which is 19% damage in the whole orchard. The extrapolated figure of

Table - 13

PERCENT FRUIT DAMAGE ON THE SAMPLED BRANCHES OF GUAVA TREES

S.No.	Total No. of Fruits on four sampled branches	Damaged Fruits on sampled branches	Damage (%)
T1	154	26	16.8
T2	117	21	17.9
T3	119	25	21.0
T4	124	23	18.5
T5	123	21	17.0
T6	139	19	13.6
T7	188	29	15.4
T8	166	31	18.6
T9	128	25	19.5
T10	163	16	9.8
T11	142	26	18.3
T12	164	24	14.6
T13	137	28	20.4
T14	149	29	19.4
T15	144	26	18.0
T16	204	49	24.0
T17	185	36	19.4
T18	152	53	34.8
T19	137	29	21.1
T20	141	35	24.8
T21	178	33	18.5

T22	150	29	19.3
T23	165	25	15.1
T24	121	28	23.1
T25	164	28	17.0
T26	142	24	16.9
T27	156	37	23.7
T28	178	47	26.4
T29	136	18	13.2
T30	115	19	16.5

$n = 30$, $\bar{x} = 19.08$ SD $\pm$ 4.6

Table - 14

DAMAGE TO UPPER & LOWER BRANCHES OF THE 30 SAMPLED TREES IN A GUAVA ORCHARD

S. No.	Damage on 4 sampled Branch B_1	B_2	B_3	B_4	Damage two on upper branch (%)	Damage on two lower branch (%)
T1	18.9	13.3	16.1	19.5	16.1	17.8
T2	15.3	22.5	12.1	24.0	18.9	18.0
T3	25.0	19.3	20.0	19.4	22.1	19.7
T4	24.0	25.9	16.6	11.9	24.9	14.2
T5	24.0	16.6	13.3	15.6	20.3	14.4
T6	19.2	17.1	13.1	7.5	18.1	10.3
T7	17.3	17.0	15.0	12.1	17.1	13.5
T8	23.5	18.6	10.0	21.8	21.0	15.9
T9	23.3	21.0	17.8	15.6	22.1	16.7
T10	13.1	13.8	6.3	7.1	13.4	6.7
T11	21.4	15.1	17.0	20.0	18.2	18.5
T12	15.0	17.7	12.1	14.2	16.3	13.1
T13	21.8	18.4	26.6	16.2	20.1	21.4
T14	20	20.9	17.1	19.3	20.4	18.2
T15	24.3	20.0	14.6	13.8	22.1	14.2
T16	38.2	26.9	15.7	16.6	32.5	16.1
T17	20.5	26.3	19.6	14.0	23.4	16.8
T18	29.3	42.4	29.2	25.0	35.8	27.1
T19	25.5	28.1	13.9	20.0	26.8	16.9
T20	42.1	25.7	20.0	10.5	33.9	15.2
T21	28.2	19.1	16.6	12.0	23.6	24.3

Continued

T22	30.0	21.6	13.9	15.0	25.8	14.4
T23	17.0	21.0	13.1	10.4	19.0	11.7
T24	34.7	24.1	14.2	21.8	29.4	18.0
T25	21.0	17.7	15.0	14.6	19.3	14.8
T26	20.0	16.6	17.2	13.8	18.3	15.5
T27	30.7	34.3	11.3	23.5	32.5	17.6
T28	40.0	23.6	20.0	21.0	31.8	20.7
T29	11.4	16.6	12.5	5.1	14.0	8.8
T30	17.8	18.7	20.0	6.6	18.2	13.3

$n = 60$, $\bar{x}$ 22.6, $\bar{y} = 15.7$ ($t = 4.24 > 2.660$ at $P = 0.01$)

Table - 15

TOTAL FRUITS, TOTAL DAMAGED FRUITS AND PERCENT DAMAGE PER TREE (ON EXTRAPOLATION)

Tree No.	Total Fruits/Tree	Total Damaged Fruits/Tree	Total Damage (%)
1.	312	56	17.9
2.	270	47	17.4
3.	330	66	20.0
4.	217	42	19.3
5.	277	45	14.7
6.	280	40	14.7
7.	360	56	15.5
8.	378	72	19.0
9.	320	25	7.8
10.	328	32	9.7
11.	216	42	19.4
12.	342	54	15.4
13.	240	49	20.4
14.	222	42	18.9
15.	288	56	19.4
16.	459	108	23.5
17.	276	54	19.5
18.	304	105	34.5
19.	306	63	20.5

Table - 16

TOTAL DAMAGE IN THE ORCHARDS BY PARAKEETS

Total No. of Trees	Total Fruit on Trees	Total Damaged Fruits in Orchard	Overall damage (%)
147	44100	8379	19

PERCENTAGE OF FRUITS DAMAGED ON THE UPPER & LOWER BRANCHES

Branches	Total fruits on sampled branches	Total Fruits damaged	Damage (%)
Upper	2190	527	24.06
Lower	2223	348	15.65
	4413	875	19.85

19% is again not different from 19.08% damage on the 120 sampled branches of 30 sampled trees (Table 16). This reliability of extrapolated figure can be used when large areas are sampled for damage assessment.

The 19% damage in the guava orchard is in presence of manual scaring by one person and using indigenous device Khatka (drum hanging on trees which is pulled by a string from one point). Though this device was able to scare birds in the beginning but as time elapse birds get used to it. At occasions when Khatka was sounded next to the tree on which birds were feeding it was not able to scare away the birds.

The result obtained from the quantification of damage by roseringed parakeets shows that is higher on the upper branches and lesser on the lower branches. This could be due to easy access for birds in the upper canopy and better sight of fruits as well as for some defense purpose.

The damage of 19.08% is significantly high in presence of one man scaring that is probably due to nearby rosting sites and perch availability. It is expected that degree of damage to be lower in plaintation away from roost site and other trees which provide perch to these birds during feeding period.

CROP FIELDS :

Regular repeated observation in the crop fields right from the sowing stage were taken. The observation shows that parakeets attack the field only from milky to dough stage and no single observation were recorded at any other stage of crop viz. - sowing, sprouting etc. On the basis of this the damage was quantified before the harvest of the crop as the feeding was maximum during dough stage. Bhatnagar (1976) also reported Roseringed parakeet among the psittacids which attack the crops when the grain setting is complete.

The maize field which was 200 mts. away from the roosting site of roseringed parakeets experienced a cumulative damage of 95.7 cobs in an area of 0.375 hectares at an average percent loss of 10.1%, SD ± 1.82 (Table-17). This was significantly greater than the other experimental field 500 mtrs from the roost. The second experimental maize field experienced a loss of 49.2 cobs in an identical area, averaging 5.1% SD ± 1.98 loss to the maize cobs(Table 18).

Damage in the bajra (pearl millet) was analysed on the basis of walked transects with 25 simpling points, in all 125 earheads in each field were sampled for damage assessment.

Table - 17

DAMAGE TO MAIZE COBS BY ROSERINGED PARAKEET IN A FIELD 200 MTRS FROM THE ROOST

Row No.	COBS UNDER DIFFERENT DAMAGE CLASS						Total COBS IN A ROW	TOTAL COB DAMAGE IN A ROW	PER-CENT LOSS
	0	1/8	1/4	1/2	3/4	1			
1.	40	6	5	6	4	0	61	8.0	13.1
2.	38	4	9	5	2	0	58	6.7	11.5
3.	45	5	7	4	4	0	65	7.3	11.2
4.	43	6	10	3	3	0	65	7.0	10.7
5.	51	9	5	5	2	0	72	6.3	8.7
6.	37	4	9	5	1	0	56	5.5	9.8
7.	32	8	6	4	2	0	52	6.0	11.5
8.	40	5	8	7	3	0	63	8.3	13.1
9.	35	3	6	3	2	0	49	4.3	8.7
10.	55	5	9	6	2	0	77	7.3	9.4
11.	53	2	6	5	2	0	68	5.7	8.3
12.	50	3	8	4	0	0	65	4.3	6.6
13.	40	6	4	8	1	0	59	6.5	11.0
14.	43	8	8	7	0	0	66	6.0	9.0
15.	53	6	5	4	3	0	71	6.5	9.1

$\bar{x}$ = 10.1, SD $\pm$ 1.82

Table - 18

DAMAGE TO MAIZE COBS BY ROSERINGED PARAKEETS IN A FIELD 500 MTRS AWAY FROM THE ROOST

Row No.	COBS UNDER DIFFERENT DAMAGE CLASS						Total COBS in a Row	Total COB damage in a Row	Percent Loss
	0	1/8	1/4	1/2	3/4	1			
1.	57	2	5	1	3	0	70	4.2	6.0
2.	54	3	3	1	1	0	62	2.3	3.8
3.	44	2	3	2	0	0	51	2.0	3.9
4.	61	4	5	2	1	0	73	3.5	4.7
5.	59	2	3	4	1	0	69	3.7	5.4
6.	72	5	3	2	0	0	82	2.3	2.8
7.	47	5	6	7	0	0	65	5.6	8.6
8.	61	2	4	2	1	0	70	3.0	4.2
9.	68	3	2	3	1	0	77	2.3	3.0
10.	43	4	2	2	2	0	62	3.0	5.7
11.	48	5	3	2	1	0	59	3.1	5.2
12.	56	4	2	3	1	0	66	3.2	4.9
13.	51	2	3	1	1	0	58	2.2	3.8
14.	44	1	4	2	5	1	57	5.8	10.2
15.	56	2	3	1	2	0	64	3.0	4.6

$\bar{x}$ = 5.12, SD $\pm$ 1.98

Out of the three fields, the two fields were 300 and 200 mtrs. away from the roost while the third-one was 500 mtrs. away from the roosting site of the parakeets. The three fields varied in the degree of damage, the first sampledfield 300 mtrs away from the roost experienced loss of 31.5 earheads in different damage class (Table 19), and the percent loss in the field was 4.16% which was significantly different from the field 200 mtrs from the roost which experienced damage of 4.61% with a total of 34.6 cobs damage out of the 125 earheads in the field (Table 20).

The third experimental field (Table 21), shows a significant difference in the degree of damage as compared to the other two experimental fields. Out of the 125 earheads which were sampled 91 of them were unattacked and only 34 cobs showed incidence of feeding by the roseringed parakeet, constituting about 4.25 earheads damage out of the sampled 125. The percent loss of 0.56% nis negligible. The low degree of damage in the third field could be probably due to its distance from the roost site of the roseringed parakeet and the awns upon the earheads.

This reveals that the damage to crop fields is influenced by the distance of the field from the roost site and also by the varietal character such as earheads with awn and tightly set grains. Hybrid, quick yielding varieties with awn, shed layers of anther and tightly set grains offer great potential in minimising damage.

Table - 19

DAMAGE TO BAJRA EARHEAD BY ROSERINGED PARAKEETS IN A FIELD 300 MTRS FROM THE ROOST

S. No.	Earhead Category	No. of Earhead in Each Category	COBS Damaged in Each Category	Percent loss
1.	0	20	0	
2.	1/8	37	4.6	
3.	1/4	35	8.7	4.16
4.	1/2	27	13.5	
5.	3/4	5	3.7	
6.	1	1	1.0	

$n = 125$, $\bar{x} = 5.2$, $SD = 5.06$

Table - 20

DAMAGE TO BAJRA EARHEAD BY ROSERINGED PARAKEETS IN A FIELD 200 MTRS FROM THE ROOST

S. No.	Earhead category	No. of Earhead in each category	COBS damaged in each category	Percent loss
1.	0	25	0	
2.	1/8	33	4.1	
3.	1/4	20	5.0	4.61
4.	1/2	39	19.5	
5.	3/4	8	6.0	
6.	1	0	0	

$n = 125$, $\bar{x} = 5.77$, $SD = 7.18$

Table - 21

DAMAGE TO BAJRA EARHEADS BY ROSERINGED PARAKEETS IN A FIELD 500 MTRS AWAY FROM ROOST

S. No.	Earhead category	No. of Earhead in Each Category	Total COBS Damage	Percent lost
1.	0	91	0	
2.	1/8	34	4.25	
3.	1/4	0	0	0.56
4.	1/2	0	0	
5.	3/4	0	0	
6.	1	0	0	

$n = 125$, $\bar{x} = 0.70$, $SD = 1.73$

21.	360	64	17.7
22.	304	56	18.4
23.	287	42	14.6
24.	300	70	23.3
25.	328	56	17.0
26.	324	54	16.6
27.	390	90	23.0
28.	360	96	26.6
29.	204	38	14.7
30.	174	24	13.7

(T = 223, P 0.05) - Wilcoxons' matched pair test

MITIGATION

Mitigation of a problem is an important aspect of any scientific research and should form the basis of all ecological research related to pest species in particular. Some of the researches in the recent past have been on the vertebrate pest species and more particularly on Avian pest species.

Birds have been associated with the agriculture and the problem of pest species is since the practice of agriculture. Indigenous methods like scare crow drum beating, sling shots and shouting are in the use since the start of agriculture. Bird damage to crops and plantation occur when alternative resources are not available to the birds (Newton 1968). But the birds like parakeet and other birds affecting agriculture have adjusted themselves to the environs and hence largely depend upon crops and fruits for their survival. There is a need to evolve sound management policy to check this problem. Workers such as Beri et al (1968), Bhatnagar (1976), Mathews et al (1980, 1988), Tobin et al (1988), Wilson et al (1989), Conover (1989), Bruggers et al (1988) have worked on the problem birds and their management in India and abroad.

Some of control measures suggested by them have been used in Indian conditions with varying degree of success. Mechanical devices like nylon nets, pyrotechniques and bioacoustics are few of them. Among chemical control measures frightening substances, repellent, detrrent, stupefying substances, contact sprays and chemicals causing stresses have been tried in different areas. One device could be effective for a particular species or group of species in an area but it cannot be applicable everywhere. Chemicals have their own toxic effect and should not be used very frequently unless it is unavoidable. The cost effectiveness of devices is another limitation which cumulatively makes the control of problem birds more complex. Other devices like bird scaring reflecting tape, habitat manipulation and cultural practices needs to be researched carefully.

In the present study two 25 X 25 metre plots of bajra were tried with bird scaring reflecting tape (Fig.9) but observations could not be continued after the first day as it was broken by the locals. The first day 8 birds flew into the sample plot 1 and 6 on the sample plot 2. The birds included house sparrows (5), pied bush chat (1), pied myna (2) in the first plot and in the second plot roseringed parakeet (1), house sparrows(3), and two pied myna. The number of birds was small, but on the basis of one day observation its effectiveness cannot be judged.

however, it was found to be quite effective in a garden in scaring away parakeets from a guava trees. Bhatnagar, (1976),.) finds its effective in scaring birds from crop field. Contrary to it Tobin et al (1988) observed it to be ineffective in protecting ripening blue barries from bird damage.

HABITAT MANIPULATION

Alternation in habitat for feeding sites, roosting sites, communal roost, nesting sites could be useful in minimising the damage to crops and orchards. In the present study the sample plots were selected keeping in mind the roosting places of parakeets which have communal roosts. The two maize fields one 200 mtrs. and other 500 mtrs from the roost experienced varying damage. The field which was closer to the roost experienced more damage (10.1%) than the field away from the roost. Similarly observations in bajra Pennisetum typhoides also showed marked difference in degree of damage in the two fields one closer from the roost and other away from it. Bhatnagar et al (1978, unpubl), observed that blocks closer to the roosting site experienced more damage in the wheat crop.

CULTURAL PRACTICES

Some cultural practices could be effective in reducing the damage by birds in crops and orchards. The crops in which damage is at sowing stage, seeds can be coated with colors, Sowrn deep or can be sown in sig-zag way or even sowing can be preponed or postponed. Delayed sowing for those areas where migrants come could be very errective (Wilson et al). For areas visited by migrants, the rarmer could be inrormed about the arrival and sowing can be either pre-or post dated. Damage at seedling or sapling stage could also be averted in the same way for migrants. For protection against resident birds such as crows in the area feeding on the seedlings of wheat rice a different strategy has to be adopted. Incidence of damage at seed maturity stage can be averted thought the cultivation of either quick maturing variety or late sowing of crop, in case of migrants. While resident birds like parakeets, sparrows, pied and bank myna which do considerable damage to crops in the area this measurement will be ineffective.

The results obtained from the quantification of crop damage by parakeet shows that roost site is important factor in case of parakeets in terms of degree of damage.

Nearer the roost, greater the damage. Out of 3 sampled plots of bajra, two were simple varieties 'kanchan' 1001 without awn and one variety with awn and compact seed setting. The two fields of kanchan 1001 were 300 and 200 mtrs away from the roosting site while the third of bajra variety with awn and closely set grains was 500 mts away from the roost and no tree in the vicinity. Out of the two fields of kanchan 1001, the one 300 mtrs away from the roost suffered slightly less damage than the other which was 200 mtrs from the roost which is not significant. But the third field, 500 meters away from the roost and with awn variety and closely set grains experienced only 0.56% damage (Table 21) which is negligible. This could be a combined effect of distance from the roost as well as the varietal factors which offer resistant to damage by these birds. Varietal characters in bajra against crop damage has been experimented by Beri et al (1968), and the bajra varieties without awns and without shed layers of anthers experienced more damage than the hybrid varieties with awan and with shed layers of anthers.

Similarly in the experimental plots of two maize crop showed results that the field away from the roost experienced less damage than the one closer from the roost. Field 500 meters from the roost suffered to 5.1% damage while field 200 meters away from the roost suffered 10.1% damage.

At the end it can be concluded that hybrid high yielding varieties with awn and shed layers of anthers and quick maturing varieties of bajra and closely set grain variety of maize can offer potential protection against the avian pest species. Roosting sites in parakeets is of great importance and the degree of damage can be minimised by manupulating the habital i.e. removing those roost sites and scaring birds from the roost sites of parakeet.

Inter-specific interaction

The northern roseringed parakeet is dependent on agricultural crops and fruit plantations and common fruiting trees for its food. There are quite a few bird species whose food requirements are taken care of by the agricultural crops and fruiting trees and hence they directly or indirectly interact with the roseringed parakeet. Some of the commonly occuring birds whose habitats as regard to feeding, overlap with parakeets are discussed here.

(1) Common House Sparrow (Passer domesticus): These birds are one of the most numerous birds in the area. They are seen in large flocks around the agriculture fields, grainaries and near human settlements. A flock of 700-800 birds was once seen in the bajra field. They said the crop in large flocks from nearby roost and feed voraciously upon the seeds. They perch upon the earhead and feed by picking out seeds by its strong bill adapted for feeding upon these seeds (Fig.10).

(2) Pied Myna (Sturnus contra) : The pried myna affects the agricultural crop fields and areas around human habitation. They along-with parakeets feed upon the seeds of bajra, jowar and maize from milky to dough stage. While feeding they were generally seen in a party of 2-3 birds and some time feed in singles also (Fig. 11). They are omnivorous as well as their feeding habit is not wasteful like parakeets and so these birds apparently does not cause any damage.

(3) Common myna (Acridotheres tristis) : This bird is fairly common in the study area and like pied myna it is frequently seen in areas around human habitation. They have been observed feeding on bajra and sorghum seeds in the study earea. Being omnivorous and wide range of food item from insects to foods they have compensative value from economic point of view.

(4) Rock Pigean (Columba livia) : Commonly seen in the agricultural fields at sowing and at post-harvest stage. They pick the grains from the ground and have never seen feeding on standing crops.

(5) Little Brown Dove (Streptopelia senegalensis) : Occurs in small parties and like rock pigeon feeds upon fallen seeds of bajra, sorghum rice and certain weed seeds. They do not inflict any damage to crops, but could be a potential disseminator of weed seeds.

(6) Red vented Bulbul (Pycnonotus cafer) : These redvented bulbuls are purely frugivores and are commonly seen on fruits plant like guava, fig, and other Ficus species. In the guava orchard where the intensive study was carried out, they are fairly common and share the feeding site of parakeets. These birds mostly feed upon ripen fruits of guava. The ripen fruits eaten by bulbuls are some time fed by parakeets also, but quite oftenly bulbuls feed upon ripen fruits which have been previously attacked by parakeets. The ripe fruits eaten by bulbuls and parakeets have more infestation of fruit flies Dacus zonatus particularly in the monsoon crop.

Blossom headed parakeet (Psittacula cyanocephala) - First report from Aligarh:

Theugh the distributional range of blossom headed parakeet in the whole peninsula, they rarely occur in the area. While taking observation in the guava orchard 5 blossom headed parakeet (3 males & 2 females) were sighted at 1230 hours on 17.01.1988, these birds were seen on three successive days and after that they were never seen. They were never reported from the Aligarh region before this sighting.

CONCLUSIONS

The study of food and feeding behaviour of the *roseringed parakeet is an important aspect for estab*lishing its status as pest of agricultural crops and orchards. The basis of existence of earth depends upon food to eat, avoidance of chance of being eaten and finding a suitable partner to male. Only those individuals servive who are able to meet this demand and make a judicious use of the resources backed by perfect strategies (Owen 1980). The repertoire of strategies for specific behavioural acts i.e. feeding, breeding and various other acts varies from one animal species to another and to some extent slight individual variations (Manning 1975).

The roseringed parakeet which inhabits the agricultural environs surrounding human habitation is perfectly adapted to the available conditions and very efficiently utilises the available resources. This bird is a strictly vegetarian bird and at no instance it was seen feeding on any animal food item. Activity of parakeets begins at dawn and continues till 1000 hr, though the feeding is

at peak during 0080 hr to 0090 hrs.

In crop fields parakeet actively feeds in the morning shifts and it is low in the evening shifts. The noon shift is marked by almost no activity from feeding point of view. Feeding in guava orchard is not very distinct as far as feeding session is concerned. But the feeding frequency was certainly greater in morning and evening shifts 80.7% to 70.1% respectively as compared to 41.2% in the noon shift. The feeding intensity is 64.8% of the total observation.

The broad spectrum of food items and its efficient use by the parakeets is an outcome of adaptations in these birds, which is governed by resource availability, type of resource and its exploitation. The foraging and feeding are related to bill morphology, anatomy and type of feet. The zygodactylous feet, sharp, curved,stout,bill of parakeets enhances the feeding efficiency. The method in which a earhead or cob or fruit is handled and utilised is a facultative response and is determined by the size of the food relative to its anatomical features viz. bill size gape width and type of feet.

The food items of parakeets ranges from different fruits bark, pods, petals of flowers, cobs and earheads of crops. The maximum number of trees fruiting is between May - July when 8-9 species of trees are fruiting Ficus spp.

Dalbergia sisoo Mangifera indica, Terminalia arjuna, Delonix regia are some of them. The peak fruiting from May to June is when there is no seed grains available except for maize where grain setting starts in July and is ready by August. After August quite a few crops, like bajra, maize, millet, sesame are ready alongwith some of the fuits. (Fig.11).

For quantification of damage it is must to identity the indirect evidences of feeding by parakeets. This was done by observing them in field and taking note of their feeding method, the way fruits, cobs and earheads are cut. Feeding signs of parakeets are easily distinguishable by the way, they are cut.

The guava fruits are identified by the deep cut (1-3/4"),and the size of the gnawed parts which are dropped down (1-1.5 cm) in length which is reflective of its bill size & shape. The gnawed part is more or less traingular in shape. In maize the leafy bracts of cobs are irregularly cut and after removing the silk the milky seeds are taken out with the husk. In bajra also the earheads are cut mostly lengthwise and grains are removed alongwith busk, thus exposing the stalk of the earhead (Fig.7).

Damage was quantified on the basis of identification of parakeet damage signs just before the harvest.

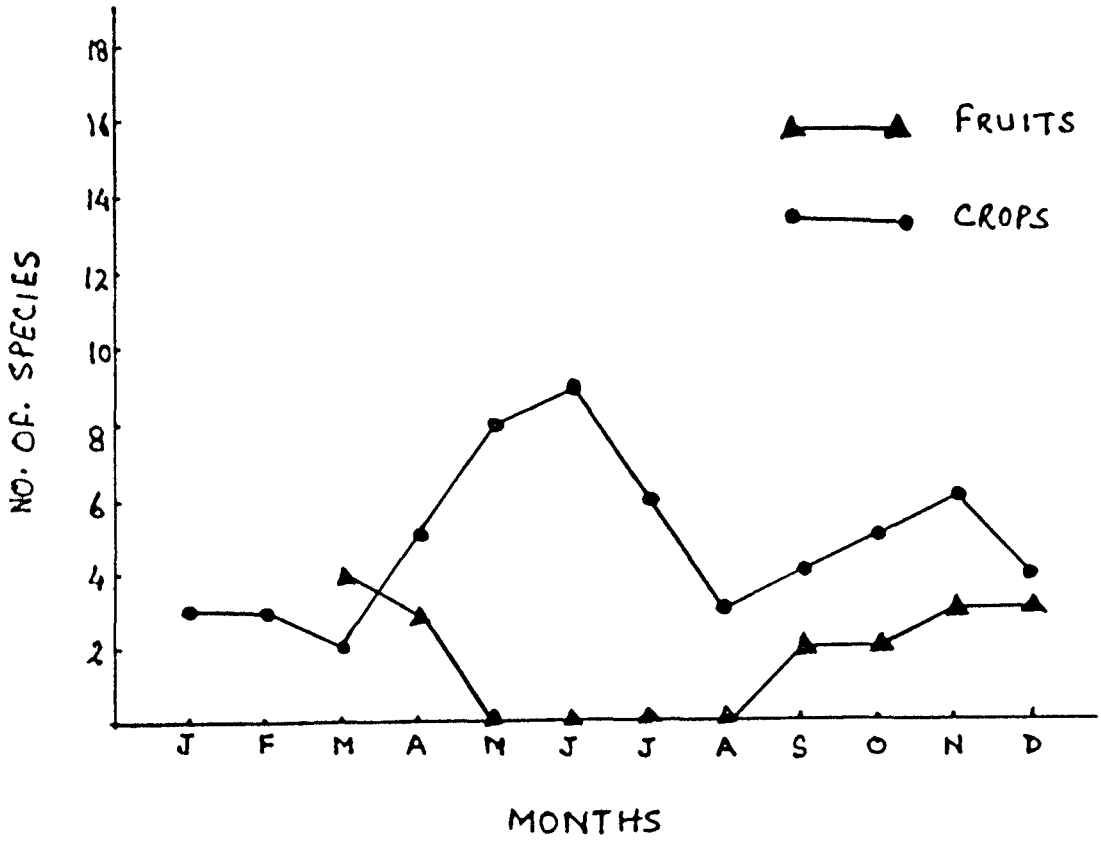

Fig. 11 : Showing the availability of different fruits (●) and crops (▲) for parakeets (1987-88).

For damage assessment transect based random sampling method (Mainkowski & Da Camara Sweets 1978) Ramza & Toor (1971), Shafi, et al (1984), Schmid & Yousuf (1988) was used. The basic idea behind the preference of this method over other method like estimation of grain loss is that the latter is very time taking and only a very small area can be covered. The process of grain counting in the number of earheds is cumbersome and the visual estimation of earneads, based on transects is quicker & less tedious. This method could be very effectively used to get the information on the pest status of a species for large areas, where a good number of fields can be sampled for damage assessment in a short span of time.

The result of the damage analysis on the guava orchard shows that the overall damage of 19.08% is significant in the presence of scaring by one person using manual scaring device. Toor (1972) reported 20.07% damage in guava fruits in Punjab. The damage could have been better explained in presence of some census data in the orchard which couldn't be collected. There is significant difference in the magnitude of damage on the upper and lower branches, which could be due to easy access and secondly due to safety from predators. The damage in the crop fields of maize and bajra was significantly high in the fields nearer to the roost and less in the fields away

from the roost. The maize field 200 meters from the cob experienced 95.7 cobs in 0.375 hect. area and the second sampled field 500 metres from the roost, a total of 49.2 cobs were damaged by parakeets in an identical plot. The percent loss was 10.1% in the first field to 5.1% in the second field. In the three field with an area of 50X50 mtrs. (0.25 hectares) each a total of 125 earheads were sampled in each. plot. The two fields 300 and 200 metres away from the field experienced damage of 4.16% and 4.61% respectively, but the field 500 mitrs away from the roost, which was hybrid variety of bajra (earheads with awn and compactly set grains) experienced a damage of 0.56% which is negligible.

The cropping pattern in the area has been identified in two broad categories, based upon the seasons i.e. the Kharif based and the Rabi based. The cropping patterns have been recognised on the basis of area under each crop. On the basis of this two cropping patterns, the bajra based and maize based in Kharif seasons and wheat based in the Rabi season. The area under bajra has declined from 111049 hectares in 1976-1977 (Table-4) to 76889 hectares in 1987-88 (Table-8). Though there has been decrease in the area under bajra in the

last ten years, still the cropping pattern is bajra & maize based in the area.

The feeding habits of roseringed parakeet in relation to agriculture is more related to the crops of bajra, maize and wheat, henceforth it is imperative to visualise the affect of feeding on these crops, for the whole district before chalking out a management plan.

The study suggests that distance of the crop fields from the roost site and nearby perching tree accentuates the damage and varietal characters minimises the damage. In the case of the Northern roseringed parakeets which do damage to crops and fruit trees, without any compensating virtue from economic point of view, the habitat manipulation i.e. scaring birds from the roost site, destroying the nesting sites and even destroying the roost could be practised. Cultural practises and new hybrid high yielding varieties with compactly set grain, earheads with awn, shed layers of anthers, and other varietal characters which offer potential resistance against the birds could be effectively used.

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APPENDIX-I

FAUNA OF THE AREA

(i) REPTILES

S.No.	Scientific Name	Common Name
1.	Naja naja	Indian Cobra
2.	Ptyas mucosus	Common Rat Snake
3.	Bungarus caeruleus	Common krait
4.	Mabuya carinata	Common skink
5.	Calotes versicolor	Common garden lizard
6.	Varanus bengalensis	Monitor lizard

(ii) BIRDS

1.	Podiceps ruficollis	Little Grebe
2.	Phalacrocorax fuscicollis	Indian shag
3.	Phalacrocorax niger	Little cormorant
4.	Anhinga rufa	Darter
5.	Ardeola striatus	Little Green Heron
6.	Ardeola grayii	Pond Heron
7.	Bubulcus ibis	Cattle Egret
8.	Egretta intermedia	Smaller Egret
9.	Egretta garzetta	Little Egret
10.	Egretta qularis	Indian Reef Heron
11.	Nycticorax nycticorax	Nigh Heron
12.	Ixobrychus sinensis	Yellow Bittern
13.	Mycteria Leucocephala	Painted stork

14.	Ephippiorhynchus asiaticus	Blacknecked stork.
15.	Platalea leucorodia	Spoonbill
16.	Anser anser	Grey lag Goose
17.	Anser indicus	Barheaded Goose
18.	Dendrocygna javanica	Lesser istling Teal
19.	Dendrocygna bicolor	Large whistling Teal
20.	Tadoma ferruginea	Brahminy Duck
21.	Anas acuta	Pintail
22.	Anas crecca	Common Teal
23.	Anas poecilorhyncha	Spotbill Duch
24.	Anas platyrhynchos	Mallard
25.	Anas strepera	Gadwall
26.	Anas penelope	Wigeon
27.	Anas querquedula	Garganey
28.	Anas clypeata	Shoveller
29.	Netta rufina	Redcrested Pochard
30.	Aythya ferina	Common Pochard
31.	A. nyroca	White Eyed Pochard
32.	Nettapus coromandelianus	Cotton Teal
33.	Sarkidirnis melanotes	Comb Buck
34.	Milvus migrans	Pariah
35.	Accipiter gentilis	Goshawk
36.	Accipiter badius	Shikra
37.	A. nisus	Sparow hawk
38.	Gyps bengalensis	Indian white backed vulture
39.	Neophron perchopterus	Scavanger Vulture
40.	Circus melanoleucos	Pied Harrier

41.	Circus aeruginosus	Marsh Harrier
42.	Francolinus francolinus	Black Partridge
43.	Francolinus pondicerianus	Grey Patridge
44.	Coturnix coturnix	Common Quail
45.	Pavo cristatus	Common peafowl
46.	Grus grus	Common Crana
47.	Grus antigone	Sarus crane
48.	Anthropoides virgo	Demoisella Crane
49.	Amaurornis akool	Brown Crake
50.	Amaurornis phoenicurus	White Dreasted water hen
51.	Gallinula chloropus	Moorhen
52.	Porphyrio porphyrio	Purple Moorhen
53.	Fulica atra	Coot
54.	Hydrophasianus chrurgus	Pheasant Tailed Jacana
55.	Metopidius indicus	Bronze winged Jacana
56.	Himantopus himantopus	Blackwinged stilt
57.	Himantopus himantopus	Blackwinged stilt
58.	Recurvirostra avosetta	Avocet
59.	Vanellus indicus	Redwattled Lapwing
60.	Vanellus spinosus	Spurwinged Lapwing
61.	Vanellus malabaricus	Yellow-wattled Lapwing
62.	Charadrius dubius	Littleringed Plover
63.	Charadrius alexandrinus	Kentish Plover
64.	Numenius arquata	Curlew
65.	Limosa limosa	Blacktailed Godwit
66.	Tringa stagnatilis	Marsh sandpiper
67.	Tringa nebularia	Greenshank

68.	T. ochropus	Green sandpiper
69.	T. glareola	Wood sandpiper
70.	T. hypoleucos	Common sandpiper
71.	Gallinago minima	Jack snipe
72.	Calidris minuta	Little Stint
73.	Calidris temminckii	Temminck's stint
74.	Philomachus pugnax	Ruff and Reave
75.	Larus brunnicephalus	Brown headed Gull
76.	Chlidonias hybrida	Whiskered Tern
77.	Sterna aurantia	Indian River Tern
78.	Columba livia	Blue Rock Pigeon
79.	Streptopelia decaocto	Indian Ringed Dove
80.	Streptopelia tranquebarica	Red Turtle Dove
81.	Streptopelia chinensis	Spotted Dove
82.	Streptopelia senegalensis	Little Brown Dove
83.	Psittacula krameri	Roseringed Parakeet
84.	Psittacula cyanocephala	Blossomheaded Parakeet
85.	Clamator jacobinus	Pied Crested Cuckoo
86.	Eudynamys scolopacea	Koel
87.	Centropus sinensis	Crow-Pheasant
88.	Athene brama	Spotted Owlet
89.	Apus apus	The swift
90.	Apus affinis	House swift
91.	Ceryle rudis	Lesser Pied Kingfisher
92.	Alcedo atthis	Small blue kingfisher
93.	Halcyon smyrnensis	White Breasted kingfisher
94.	Merops orientalis	Small gree Bee-Eater

95.	Coracius benghalensis	Indian Roller
96.	Upupa epops	Horpoe
97.	Tockus birostris	Common Grey Hornbill
98.	Megalaima zeylanica	Green Barbet
99.	M. haemacephala	Crimsonbreasted Barbet
100.	Dinopium benghalense	Lesser Goldenbacked Word pecker
101.	Galerida cristata	Crested Lark
102.	Hirundo concolor	Dusky crag Martin
103.	H. rustica	Swallow
104.	H. fluvicola	Indian cliff swallow
105.	Lanius excubitor	Grey Shrika
106.	L. vittatus	Baybacked shrike
107.	L. schach	Rufousbacked shrike
108.	Oriolus oriolus	Golden Oriole
109.	Dicrurus adsimilis	Black Drongo
110.	D. caerulescens	While bellied Drongo
111.	Artamus leucorhynchus	Wood swallow
112.	Sturnus pagodarum	Brahminy Myna
113.	S. contra	Pied Myna
114.	Acridotheres tristis	Common Myna
115.	A. ginginianus	Bank Myna
116.	Dendrocitta vagabunda	Indian Tree Pie
117.	Corvus splendens	House crow
118.	C. macrorynchos	Jungle crow
119.	Tephrodornis pondicerianus	Common word shrike
120.	Pycnonotus cafer	Redvented Bulbul

121.	Turdoides caudatus	Common Babbler
122.	Turdoides malcolmi	Large Gray Babbler
123.	T. striatus	Jungle Babbler
124.	T. affinis	White headed Babbler
125.	Prinia subflava	Plain Wren Warbler
126.	Prinia socialis	Ashy Wren warbler
127.	Orthotomus sutorius	Tailor Bird
128.	Copsychus malabaricus	Shama
129.	Cercomela fusca	Brown Rock chat
130.	Saxicola caprata	Pied Bush chat
131.	Saxicoloides fulicata	Indian Robin
132.	Anthus triviates	Tree Pipit
133.	Zosterops palpebrosa	White-Eye
134.	Passer domesticus	House sparrow
135.	Ploceus philippinus	Baya
136.	Lonchura punctulata	Spotted Munia

(iii) **MAMALS**

1.	Funambulus pennanti	Five striped palm squirrel
2.	Herpestes edwardsi	Common mongoose
3.	Rousettus teschenaulti	Fruit bat
4.	Felis chaus	Jungle cat

APPENDIX-II

FOOD ITEM OF PARAKEETS IN DIFFERENT MONTH

S.No.	Month	Food Items	Parts Eaten
1.	January	Psidium guajava	Fruits
		Acacia miiotica	Pods
		Embelica officinalis	Fruits
		Delonix regia	Pods
		Zizyphus jujuba	Fruits
		Kigelia pinnata	Fruits
		Bombax ceiba	Flowers
		Zea mays	Seeds
2.	February	Psidium guajava	Fruits
		Brassica compestis	Seeds
		Triticum aestivum	Seeds
		Terminalia arjuna	Fruits
		Delonix regia	Pods
		Embelica officinalis	Fruits
		Zizyphus juguba	Fruits
3.	March	Triticum aestivum	Seeds
		Brassica compestris	Pods
		Psidium guajava	Fruits
		Bombax ceiba	Flowers
4.	April	Triticum aestivum	Seeds
		Cicer arietinum	Seeds
		Pisum sativum	Seeds

Continued.....

		Acacia nilotica	Pods
		Mangifera indica	Fruits
5.	May	Mangifera indica	Fruits
		Acacia nilotica	Pods/Bank
		Ficus carica	Fruits
		Helianthus annus	Flower
6.	June	Mangifera indica	Fruits
		Eugenia jumboiana	Fruits
		Acacia nilotica	*Pods*
		Azadiachta indica	Seeds
		Dalkigelia pinnata	Fruits
		Terminalia arjuna	Fruits
7.	July	Mangifera indica	Fruits
		Dalbergia sisoo	Pods
		Kigelia pinnata	Fruits
		Azadiachta indica	Seeds
		Terminalia arjuna	Fruits
8.	August	Psidium guajava	Fruits
		Acacia nilotica	Pods/seeds
		Dalbergia sisoo	Pods
		Kigelia pinnata	Fruits

Continued.....

9.	September	Zea mays	Seeds
		Dalbergia sisoo	Pods
		Punica granatum	Fruits
		Sorghum vulgare	Seeds
		Psidium guajava	Fruits
10.	October	Zea mays	Seeds
		Sorghum vulgare	Seeds
		Sesamum indicum	Seeds
		Dalbergia sisoo	Pods
		Punica granatum.	
11.	November	Zea mays	Seeds
		Sorghum vulgare	Seeds
		Pennisetum typhoides	Seeds
		Sesamum indicum	Seeds
		Punica granatum	Fruits
		Delonix regia	Seeds
		Embelica officinalis	Fruits
12.	December	Pennisetum typhoides	Seeds
		Sorghum vulgare	Seeds
		Psidium guajava	Fruits
		Delonix regia	Seeds
		Embelica officinalis	Fruits